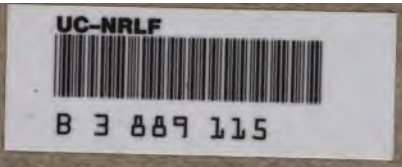

INDICATIONS OF INSTINCT.

A SEQUEL TO

"THE NATURAL HISTORY OF CREATION."

BY T. LINDLEY KEMP, M.D.

Out of the eater there came forth meat.—SAMSON.

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ADVERTISEMENT.

THE main object of this small book is to attempt to present to the traveller a little popular scientific reading, which, it is hoped, may be interesting to him; but in writing it I have also had another intention before me.

If we consider the history of physical science since the time of Bacon, we find that, from time to time, some branch of it has been held to be in opposition to principles that are derived from another source. This has particularly been the case, in succession, with astronomy and geology. Hitherto, as the subjects have been more investigated, and looked at in a broader light, this discrepancy has turned out to have no existence. Of late, the general contemplation of nature

has been maintained to establish materialism, and not to accord with the doctrine of a creative cause, or a future state of human existence; and this has, somewhat strangely, been most insisted upon by those who, in other respects, are so credulous as to believe in follies so unsupported by evidence as the doctrines of animal magnetism and the like.

My belief is, that the general contemplation of nature leads to deductions the very opposite of those referred to above, and my second intention in writing this little book has been to try to indicate this.

INTRODUCTION.

MAN is so apt to exaggerate his own importance, that we are in the habit, even when speaking pretty accurately, of defining the history of science as the history of the human mind's becoming acquainted with its principles. We sometimes talk as if gravitation had no existence until it was discovered by Newton; and we use expressions as if chemical affinities were brought into play by the French philosophers of the last century, or as if that, perhaps, most remarkable power of all —that of catalysis—was called into being but a few years ago. And yet it is evident that all these were producing their wonderful results long ere mankind appeared upon the scene; and the true definition of the history of science is that which gives an account of the successive developments or creations of scientific principles. To

do this is almost above the powers of the human mind, and little beyond a very feeble outline can be guessed at. Still we may safely conclude that science is not eternal, and that, moreover, of the scientific principles that are now in full operation, all are not equally ancient. Neither does any known scientific principle seem to be a necessary property of matter, but only temporarily communicated to it by an act of arbitrary will.

For instance, when with the geologist we study the history of the matter of this planet, we can perceive that there was a time when there were no laws of vitality in operation. We may go further, and affirm that at one time there was no chemistry, nothing but mechanics, or the principle of gravitation. Indeed, at the present day, by such a heat as we can produce, we can alter and annihilate chemical affinities. And the intensity of heat that we know at one time prevailed, was such as was quite incompatible with the play of chemical affinity. The matter that formed the globe then was that which forms it now, but every element must have been by itself in a state of vapour; and in the vast nebulous mass that the world would *present no* alliances were possible. Accordingly when

we come, at the present day, to examine those elements that we know would first cease to be vapour and solidify, we still find them alone. Gold and platinum never occur in ores.

Indeed, it is possible that there have been two chemistries—the one that now is, and one, possessing other affinities, that intervened between its occidence and the time when gravitation ruled alone. At any rate, while we can synthetically construct almost all minerals, there is one which we have no power of artificially forming. Let us torture carbon as we will, we cannot obtain a diamond; and that gem must have been formed under the influence of laws of which we are altogether ignorant, and which perhaps do not now exist. The diamond is to the chemist what the mastodon is to the geologist —a thing of the past. Nay, although it is perhaps refining too much, it is not unlikely that, ere matter was endowed with gravitation, it was subjected to other laws, and that a science was then in existence, the nature and principles of which, at least as mortal beings, we shall never know.*

* The idea suggested in the text, of the successive creations of sciences, or endowments of matter, seems to accord with the Mosaical

However this may be, we are entitled to affirm, that at one time the only great scientific principle that was at work was that of gravitation, under the influence of which the gases and vapours that constituted this globe were held together, and prevented from flying off into space. And also, that subsequently matter, or at least the elements that compose the crust of the earth, was endowed with those wonderful chemical properties by means of which some elementary bodies (for all practical purposes some dozen only in number) unite together in such proportions as to form the infinite variety of compounds that are to be found in the earth, the water, and the air.

Both these two principles of mechanics and of chemistry may be regarded as the development of the powers of motion. Gravitation is a property possessed equally by all particles of matter, and which makes

cosmogony. According to Moses, "in the beginning," as far as relates to this planet, or rather planetary system, matter was called into being —"in the beginning, God *created* the heaven and the earth." The next recorded step is the creation of light; after that a separation of the elements, or the birth of chemistry; and then vegetable life or *physiology appears* upon the scene.

them tend to fall towards a common centre. Chemical affinity, again, is a property with which the different elementary principles are variously endowed, and which make the particles of any two (or more) elements, if they are very near to each other, approach still nearer, and form an union. How long the world rolled on with its substances affected by none but these two powers, it is impossible to say; but about the epoch when the greywacke was in process of being deposited, a new science was created, one characterised by new motions—that of vitality, of life; or, to use the modern expression, physiology.

Under the influence of this science, portions of these dozen elements just noticed, and which constituted the greater part of the vast cloud of the mechanical world, and subsequently of the crust of this planet, when it had been put under the control of the laws of chemistry, were grouped together, and made to form separate existences—plants and animals—and which separate existences were endowed with very new and characteristic properties. Among these was a suspension or obliteration of the laws of motion, as witnessed in merely mechanical or chemical bodies, and the substitu-

tion of altogether new laws of motion. The elements composing a plant or animal, although taken from the crust of the earth, do not, as constituting that separate existence, tend to fall towards a common centre; neither do the sulphur and iron which they all contain, however close they may be put, unite and form pyrites, as in the world of chemistry. Still they have very definite and wonderful motions.

All these motions of vitalized beings may perhaps be arranged into two divisions. The one includes those movements which take place only in their own structures, without reference to any other external object, as the circulation of the sap or blood, and so forth. Of these, the little book of which this is a sequel, the "Natural History of Creation," attempted to give a feeble outline. The other division takes in those movements which are invariably performed when some other external object is near, and in consequence of the presence of that external object, and which are called instincts. Thus, when certain species of *Confervæ* wander about in the ocean until they find a sufficiently shady spot, where they take root and remain fixed *until they die;* when the chick knocks a hole with its

beak in the thick end of the shell in order to escape; when the bee constructs its cell; or when the *Dionæa* catches a fly, we have instances of those peculiar movements called instincts.

Many who have not particularly investigated the subject, are apt to shrink from the belief in a vitality without consciousness. But it is plain that consciousness has no necessary connection with life. All the powers of life are common to the plant and to the animal; and, as plants are more numerous than animals, there are more living beings that have not consciousness than that have. Indeed, many of the lower animals can and do remain alive while in a state of complete unconsciousness; and even in the higher a portion of their time is passed in a state of nearly complete (not, however, of quite complete) unconsciousness or sleep.

Nevertheless, there is a prevalent belief that instinctive motions only take place in beings that are cognizant of them. This it may be safely maintained is not the case. On the contrary, evidence will be brought forward in the following pages, that seems to indicate that instinctive movements are more complex and intricate in plants than in animals—perhaps more

in the lower animals than in the higher—and that, as we advance in the scale of animal life, they gradually diminish until they disappear. All these "indications of instinct" are surely not only interesting in themselves, as being, like gravitation or affinity, examples of peculiar properties of matter; but likewise as contrasting strongly with, and differing from, the operations of reason and of spirituality.

INDICATIONS OF INSTINCT.

CHAPTER I.

THE INSTINCTS OF PLANTS.

THAT varied and complicated movements take place in many plants has long been known. But such have been little investigated, and the nature and end of them have generally been passed over in silence. They are, however, very clearly examples of instinctive movement, and in many cases serve highly important and essential ends in the vegetable economy, although from our imperfect observation we cannot always point out decidedly the results that they produce.

A very familiar instinctive movement that occurs in plants, is the opening and shutting of the flowers. Generally, these organs are spread open so as to expose the stamens and pistils to the action of light during the day, and closed during the dark, so as to protect from

external injury these delicate organs. A good deal of variety, however, prevails in this respect. Some plants, as the *Portulaca oleracea*, only open their flowers for about one hour daily, and this at midday. The *Oenothera biennis*, on the contrary, keeps its flowers shut all day, and only opens them when night comes on; and when the sun rises the flowers close again unless it be a very cloudy day, in which case the plant only shuts its flowers partially, or not at all. The flower of the common dandelion generally lives two days and a half. On the first two days it is awake, and is expanded in the earlier part of the day, and shuts at night; but on the third day it closes about midday, and this closing is followed by the death of the corolla. Moisture appears necessary to plants of the *Carlina* species, (a near relation of the thistle;) and accordingly, on a dry day, the flowers shut, and thus lose no water by evaporation. When the atmosphere becomes charged with moisture, the flowers re-open. Still more remarkable is the *Nymphæa alba*, or water lily, which, when night comes on, not only closes its flower, but gradually lowers it until it is beneath the surface of the water, and thus reposes submerged.

Another example of an instinctive movement for a very definite end may be noticed in the common ber-

berry. The flower of this plant contains six stamens

which surround a single pistil; the stamens being inclined back upon the petals, and so away from the pistil. If, however, any of the stamens be touched near the base, it immediately starts forward to the pistil, and strikes the top of that organ with its anthers. It soon resumes its original position. Of course, the same effect is produced whenever an insect alights upon them. Whenever the anther is ripe, and an insect enters the flower, the filament strikes against the pistil with such force as to burst the anther, and thus scatter the pollen upon the pistil, and thereby produce a seed. There is another plant, the *Cactus tuna*, which, whenever an insect enters its ripe flowers, immediately inclines all its stamens over the pistil. In a somewhat similar manner, if the stalk of the stamen of the *Cetasetum* be disturbed, it springs up with such violence, that the top of it is broken off, and actually darted to a very considerable distance.

The motions of the leaves of plants must have been noticed by every one. The most common instances of such are called, in ordinary language, the sleep of plants, although the expression is a bad one. The phenomenon was first noticed by Linnæus. He was carefully cultivating some lotus plants, or birds'foot trefoil, one of which had two flowers. Chancing to look at the plant one evening, the flowers were not to be seen, and Linnæus supposed that some one had plucked them. The

next morning, however, they were again visible, but on returning at night they had once more vanished. The plant was then carefully examined, and it was found that the leaflets had altered their position, approached one another, and by so doing concealed the flowers. Extending his observations, Linnæus found that something analogous to this occurred in all plants. Generally this folding of the leaves takes place as darkness comes on, but is in reality performed independently of light and darkness; and it has been ascertained, that plants kept constantly in the dark, open and close at regular intervals. It by no means follows that the leaves of plants close in this manner at the same hour that the flowers do. Berthollet watched an acacia, the leaflets of which closed at sunset, and unfolded at sunrise, while its flowers closed at sunrise and expanded at sunset.

The manner in which leaves change their position is various. Some raise their leaflets so that their upper stalks are brought into contact, while others depress theirs so that their under surfaces meet together. Others, again, undergo other contractions.

The sensitive plants afford very striking illustrations of movements performed by vegetables. The most common of these is the *Mimosa pudica*, an annual, the leaves of which fold up on being touched, the phenomenon taking place at so early a period in the existence of

the plant as from when its cotyledons have expanded. If the stimulant be applied in sufficient intensity—as if, for example, a leaflet be touched with a burning candle, or if the sun's rays be concentrated upon it by means of a line, this leaflet immediately moves, and also the one opposite to it; both bringing their upper surfaces into contact, and at the same time inclining forwards or towards the extremity of the small petiole on which they are seated. Then other pairs of leaflets, nearest to that pair first touched, close one after the other in a similar manner, and next the partial petioles fold together by inclining upwards and forwards, after which the common petiole is affected, but it bends downwards, having its point directed towards the ground; that is, in an opposite direction to that in which the previous movements have been made.

Many other plants possess this property of taking on them extraordinary motions when any thing comes into contact with them. The object effected by them all is, probably, to shake off slugs and similar vermin. Among these other plants, the leaves of which assume these contortions, are species of *Smithia* and *Biophytum;* and, in Senegal, a plant grows called by the natives "how dy'e do," on account of its performing a sort of salaam or bow on being touched.

In some species of plants the mere contact of the air

apparently seems sufficient to excite a continual degree of spasmodic action, if the expression may be allowed, for the sake probably of protecting themselves from the depredations of insects. There is, for example, the *Desmodium gyrans*, a native of Bengal, where it is called *gora chand*, and which was brought into notice by the younger Linnæus. "No sooner," wrote he, "had the plants which he raised from seed acquired their ternate leaves, than they began to be in motion in every direction: this movement did not cease during the whole course of their vegetation, nor were they observant of any time, order, or direction; one leaflet frequently revolved while the other on the same petiole was quiescent, sometimes a few leaflets only were in motion, then almost all of them would be in a movement at once; the whole plant was very seldom agitated, and that only during the first year of its growth, and was not at rest even during the winter." Examples of this plant that have been cultivated in our greenhouses, although they have exhibited very well these strange movements, have not been agitated so much as when growing in their native country, or as those brought thence by Linnæus. This is probably owing to the careful culture of our gardeners, and to the climate, both of which preserve them from the more active of their insect tormentors. Burnet, who *watched* their movements in a glass conservatory, made

the rather remarkable discovery, that although they might be temporarily restrained by force; yet that, when the restraint was removed, they immediately moved about with increased velocity, so as to make up for the time which they had lost. Decandolle also observed them, and he related that their leaves consist of three leaflets, two lateral, and one central and terminal. Their movements, he describes, take place by little starts, like those of the second hand of a watch; and he further remarked that the one at one side went up, so as to form an angle of about fifty degrees over the level of the petiole, and the other on the opposite side went down as much. This process was then reversed, and repeated alternately. The terminal leaflet is also continually inclined first to one side and then to the other.

There is a natural family of plants principally inhabiting tropical countries, and abounding at the Cape of Good Hope, where they are objectionable on account of the extremely fœtid nature of the odour of their flowers, examples of which are occasionally cultivated here. The members of this family afford very extraordinary instances of instinctive movements. Plants belonging to it are known from all others by having their pollen grain contained in bags, from which their escape seems almost impossible. However, when the time comes for their seeds to be formed, a small tube grows from each

pollen grain, and these tubes all direct themselves towards a thin spot of the bag which holds them. This they pierce, and then direct themselves towards the stigma. To effect this object they have sometimes to ascend, sometimes to descend, and at other times to proceed outwards at right angles; but they invariably hit the exact direction, according to the position of the flower, and arrive at the stigma, and thus the seed is fertilized.

A plant grows wild in Carolina called the *Dionœa muscipula*, or Venus' fly-trap. "The leaves of this," says Henslow, "consist of a flattened petiole, at the extremity of which two fleshy lobes, which lie, when expanded, in the same plane with the petiole. These lobes are capable of being elevated and brought together into a position perpendicular to the surface of the petiole. They are furnished with *cilia*, or bristles, round their margins, which stand nearly at right angles to their upper surface; and there are, besides these, three little short bristles placed upon the upper surface of each lobe in a triangular order. When a fly or other insect, crawling over the surface of the lobes, touches either of these latter bristles, the irritability is excited, the lobes suddenly close, and the insect is imprisoned like a rat in a common gin. Some little time after the death of the insect, the lobes unfold, and wait for another *victim.*"

It appears probable that the plant makes use of the fly, although it is difficult to conceive in what manner. Mr. Knight experimented upon a number of these plants, all of which were placed so that no insects could get at them. He furnished the leaves of some with scraped beef, leaving the others without any such provision; and he found that the plants supplied with the beef flourished more than the others.

We possess in this country three species of *Drosera*, or sun-dew, all of which exhibit similar instinctive movements, the result of which is to catch insects. The upper surface of their leaves is furnished with long hairs, which terminate in glandular and viscid globules. An insect alighting upon them first gets entangled in the viscid matter, and then the hairs begin to move in, close upon it, and hold it until it is dead.

But perhaps the most extraordinary of the fly-catching plants is the one described (somewhat obscurely) by Mr. Drummond, who found it in the Swan River colony. The lower lip of the flower of it, he states, is a boat-shaped box, in which the anthers are situated, and the upper one, which he thinks is a stigma, forms a door or lid, which exactly fits it. The hinge upon which this lid moves springs from the upper part of the flower, and "when it opens, the upper part turns round within the box, comes out at the bottom, and turns up and

back, so that when fully expanded it stands fairly ove the flower. The moment a small insect touches th point of the lid it maks a sudden revolution, brings i the point of the lid at the bottom of the box, so that i has to pass the anthers in its way, and makes prisone any small insect that the box will hold." He adds that if the insect be caught, the box remains shut for som time; but that, if the animal has managed to fly out, i soon opens again.

Still more surprising acts of motion take place in th lower plants. Among the *Confervæ*, or jointed *Algæ* is a genus called *oscillatoria*, the members of whic might almost be mistaken for a number of worm writhing together. These shift their position with ver considerable alacrity. If, for example, a patch of then be placed in water in a plate, and a black bell glass b inverted over them in such a manner as not to quit touch the bottom of the plate, the *confervæ* in a ver short time will be found to have glided out at that sid of the bell glass most exposed to light. They have bee observed to travel in a few hours to a distance of te times their own length. The young of certain specie of them, too, when separated from the mother plant move onwards in the water with velocity until they reac a shady spot, when they take root and remain fixed.

The climbing plants also appear to have a kind o

tinctive motion, and those of the same species move ays in the same direction. Those that move from ht to left, never, under any circumstances, move from to right, and *vice versa*. Thus the hop invariably ns from the left to the right, and the stem of the volvulus or bindweed always turns from the right to left.

It is probable that still more remarkable instinctive vements take place under ground. The structure of nts consists of about a dozen elementary substances, of which are present in fertile soil; and it is from the l (and also, with regard to one or two elements, from air) that they obtain them. The roots send forth licles, which move on until they arrive at particles of different elements that the plant stands in need of. d the distance to which one of these radicles will so vel is often very great. Moreover, the difference ween different plants mainly depends upon the ying proportions of these elements of which their ucture, and consequently their food, is composed. The of bean, for example, is found to contain nearly y per cent. of potassa, and about six of silica; ile that of barley has not eight per cent. of potassa, d more than fifty of silica. If the half of a ld, the soil of which is quite uniform, be planted with ans, and the other half with barley, the rootlets of

the bean and barley plants wander along under ground until they come into contact with just the requisite quantities of those two substances, and when they have obtained the requisite quantities seek no more. Those of the bean plant wander on until they have formed the large amount of potassa, and those of the barley of silica; while the bean roots are content with having found the small quantity of silica, and the barley ones the comparatively small amount of the alkali.

As is familiar to every one, there is a regular gradation in the different classes of living beings. We are in the habit of pronouncing cryptogamic plants as less perfect than flowering ones, polypi as inferior animals to reptiles, reptiles to birds, birds to mammals; and among mammals we assign various degrees of rank, esteeming a dog or an elephant as superior to a sloth or a mole. It must not be supposed, however, that all the endowments go on increasing according to the scale of increasing perfection. Indeed, in one respect, in that which now employs us—the instincts—the very reverse is the case, and some of the most striking of the instinctive arts are to be witnessed in the beings that are ranked as lowest. This being the case, we should expect to find that these instinctive movements in search of food are most energetic in the lowest plants; and such is certainly the case. A fungus, as a common edible mushroom, may be at

nset a mere dot of matter, scarcely or not at all ap-
ɔciable to our senses, and may by next morning be a
ge plant that weighs a pound. This indicates an im-
ɪnse activity of its radicles during these few hours, and
egree of instinctive movement and instinctive selection
ıt is very extraordinary.

CHAPTER II.

THE INSTINCTS OF ANIMALS LOWER IN THE SCALE THAN INSECTS.

ALTHOUGH not in accordance with the usual classification, we may regard all the other non-vertebrated animals as lower in the scale than insects. The number of these is almost infinite, and the complexity of their instinctive movements very great. They are, indeed, much greater than is known, for most of them inhabit the depths of the ocean, and the observations of their habits have necessarily been very imperfect.

Several orders of these amimals are so very low in the scale, that they were long thought to be plants; and indeed, although they are known to be animals, their nervous system has never been discovered. They manifest very complex instinctive movements, and the result of some of such is very important, being in one instance actually to produce a new geology.

One class, that of the *Infusories*, consist of animals so minute that they cannot be seen by the naked eye, some

of them being so very little as not to be longer than the one two-thousandth part of a line. They are, nevertheless, universally diffused, being found in the sea, in fresh water, in the air, in blood, in animal and vegetable substances, &c. Their number too is infinite, and hundreds of thousands may exist in one single drop of water. They exist, too, in immense variety. Most of them have bristles, or tentacles, around their mouths; when hungry they rotate these, and thereby create a current of water, which flows into their mouths and brings along with it their food. It is rather remarkable that the instinctive movements by means of which these, the smallest of the inhabitants of the ocean, obtain their prey, is analagous to the instinctive art of the largest, the whale, for the same purpose. This huge animal pursues a shoal of herrings into a bay, and, by beating the water with his tail, produces a whirlpool of great violence and extent, in which the herrings are tossed to and fro. He then opens his vast mouth, into which the herrings are washed, and precipitated down his throat.*

The *Polypi* are very vegetable-looking entities, but are unquestionably of an animal nature. The marine ones generally fix themselves upon rocks; and it is noticed

* The whale that has been noticed to do this is probably the *Borqualis borealis*, or the finner of the whalers. The smaller Greenland whale is supposed to live on small molluscous animals.

that they instinctively attach themselves to those portions of the rocks where they will not be exposed to the direct shock of the tide, or to violent currents. Usually they seem to select a hollow, or "submarine grotto." When a polype has fixed itself in such a situation it commonly remains fixed by one extremity, and really looks amazingly like a plant. If, however, it do not receive plenty of light, it changes its quarters, and moves along, by alternately fixing its head and its tail upon the adjoining substances until it has reached a lighter place. It then remains fixed and motionless, save that it moves its long arms or branches to and fro. This it does in order that it may catch hold of grubs, &c., on which to feed. It has been observed, too, that, although reasoning is quite out of the question with respect to these animals, it only sends out as many branches as are necessary to master the object it requires for food, and puts one or more into requisition as the case may be. Having grasped the food, the branch gradually curves in until it presents it to a sort of mouth, which then gradually opens and receives it. The food of polypi is of an animal nature, and consists of slugs, worms, or even small pieces of meat, if they are thrown near it. All these movements, for the apprehension and selection of food, are purely instinctive.

One of the most important of these lowly organized

creatures, and one that manifests surprising instincts, is the *Madrepora*, or coral polype. This insignificant little animal is actually revolutionizing the existing state of things; it has created by its little but continuous labour almost all the islands of the Pacific Ocean that have now become of such importance, and it is still creating fresh ones, that are doubtless destined to be of importance, not only in themselves, but, by displacing a portion of the ocean, submerge existing lands. It is not easy to guess at the exact time; but, unless the economy of nature change her operations, the period is coming when that southern continent, so often assumed, will really arise from the waves, and all owing to the instinctive movements of the insignificant polype now under notice.

These coral polypi not only obtain from without the food necessary for their own structures, but they separate from the sea-water, or more probably from the sea plants, calcareous matter. This they elaborate, and form a structure to which they and succeeding generations of them gradually add, until a vast tract of territory is put down, which at last emerges from the ocean. When this is the case, they can no longer add to its surface, for coral polypi taken out of the sea die instantly. But the surface thus exposed becomes the site of vegetation, a soil is gradually formed upon it, and *then it is* taken possession of by man.

It does not appear that in making these coral reefs the coral polypi serve any purpose of their own, but it would seem that they work on blindly in obedience to a law of instinct; and yet the polypi construct these depositions in such a manner as is best calculated to resist the destroying effects of the ocean upon them, and when danger from this source is imminent, actually constructs breakwaters. Captain Beechy particularly observed a coral island, and noticed distinctly that it took the shape of a truncated cone, having its base downwards, that being the very form most suitable to protect it from the sea. Farther, he remarked "the north-eastern and south-western extremities are furnished with points, which project under water with less inclination than the sides of the island, and break the sea before it can reach the barrier to the little lagoon formed within it. It is singular that these buttresses are opposed to the only two quarters whence their structure has to apprehend danger, that on the north-east, from the constant action of the trade wind—and that on the other extremity, from the long rolling swell so prevalent in these latitudes; and it is worthy of observation, that this barrier, which has the most powerful enemy to oppose, is carried out much further and with less abruptness than the other." In fact, the instinctive labour of this semi-vegetable, the coral polypi, that scarcely

appears to have sensation, is as much more elaborate than the far-famed honeycomb of the bees, at it is more important in its results.

Nor is this all. When these little beings are constructing their island, they invariably leave a hollow place in the centre, which, when the island is completed, forms a lake. But when depositing the coral they always leave an opening into this from the sea, so as to let the tide in and out; the reason of this act that they instinctively perform being, that without this access of the tide they cannot obtain a due supply of food and of building materials.

The sea *Anemone*, as it is called, is in many respects a remarkable animal. It fixes itself to a rock, and sends out a number of what appear to be stalks, which terminate in apparent gaudy flowers. These latter are in fact germs of young ones; and those who have descended in diving-bells have sometimes been astonished to find the submerged rocks covered with what seemed brilliant blossoms. When all is quiet these apparent flowers come to the surface, but upon the slightest indication of danger they are immediately withdrawn; and on looking into the water nothing is to be seen save a fleshy-like mass, into which the animal has converted itself. The sea *Anemone* sticks so fast to the rock, that it cannot be *separated* without lacerating its structure. When tired,

however, of its position, it unlooses itself, and commits itself to the waves, until it is washed against some other surface, to which its instinct teaches it to attach itself.

There is a class of plant-like animals, called *Salpes*, which are luminous. Their structure is very frail, and resembles a thin jelly, and, on being touched, dissolves into a colourless fluid. When young, these *Salpes*, in order to protect themselves from the action of the sea, instinctively unite themselves together. "Every individual," says Bosc, "is attached by its sides to two others, the mouth of which is turned to the same side; and by its back also to two others, when it is turned to the opposite side." This union is effected by means of certain lateral suckers. When the *Salpes* have grown older, and when their structure has probably become firmer, this instinct of association ceases, and the different individuals separate.

These jellies do not adhere together when young, or separate when older, in consequence of any experience or reasoning, but both movements are purely instinctive; and, as an instance of how each different species of animal has its peculiar instinct, it may be remarked, that although these *Salpes* are so very low in the scale of creation, yet that they are the only known animal, members of which group together in this manner for mutual support.

We have seen that the coral is creating new islands and continents. Another animal, equal insignificant, is aiding in destroying existing rocks and stones. This is the stone-borer, or pholad, various species of which are common on our coasts. They are litttle bivalve shell animals, and, to look at them, they would appear devoid of all power of progression, and yet they can penetrate the hardest rock. The mode in which they bore is not indeed well known:—"These animals," says Kirby, "are defended by two very fragile shells, strengthened indeed by supplementary pieces, and rough like a file, inhabited by a very soft animal, which appears to be furnished with no organ adapted to boring so hard a substance as a rock. When the young are disclosed from the egg, being cast upon the rock in which their mother resides, they bore a hole in it, which they enlarge daily, and which they never leave unless compelled by force. This hole always communicates with the water." Reaumur made observations upon their mode of boring: he says that "it is by the rotation of the two valves of their shells, which form a rasp, and continually wear away the rock which surrounds them. The surface of the valves of the shell is wedged longitudinally and transversely, and rough with asperities at the intersections of the ridges, which seem to fit it for such an office; *but still it* is usually so tender and friable, that we would

not expect it to act upon a rock." The end fulfilled by this boring is to obtain a secure habitation; but the animal is so low in the scale—inferior to a cockle—that it cannot know at all why it is boring, but it works away in a definite manner, entirely in obedience to an instinct.

One of the lowest of the shell-fishes, as they are called, although they are not fishes at all, is the oyster. This animal seems, rather unfortunate, and besides being preyed upon by man, barnacles attach themselves to it, and crabs rush into its shell when it opens it to take in sea-water, and devour it. The oyster, however, has an instinct by means of which it often protects itself from the last intruder. It keeps a quantity of water in reserve in its shell, and, when the crab is about entering, squirts it out with such violence against him as to dash him back.

Indeed, were the habits of these bivalve animals accurately observed, it is probable that very wonderful instincts would be witnessed. They have no organ of sight, of hearing, or of smell, and no apparent means of motion, and yet they perform complicated movements. The oyster, for example, so far from being, as often thought, very apathetic, moves about a good deal. The cockle can and does burrow to a considerable depth in the sand. But the most remarkable in this respect of these creatures is, perhaps, the *Pecten*, and its ally, the

Venus genus, the members of which have extraordinary powers of locomotion; and, when those of the latter come to the surface, they use one of their valves as a boat, and hoist the other as a sail against the wind, which wafts them along.

Several molluscous animals, it may be observed, instinctively expand a portion of their structure, in order that the wind may propel them. The *Hyalæa* has an organ, or rather two organs, apparently intended purposely for sails. These it unfolds, and, aided by the wind, moves with great velocity. The *Tethys*, too, is provided with a long mantle, which it probably uses for a similar purpose.

The manner in which the common garden snail proceeds about its hybernation, affords a striking instinct of complex instinctive movements. In the autumn, these animals are led by their instincts in great numbers to the banks of ditches and similar places. There each forms a cavity in the grass, or among dead leaves large enough to contain it. This cavity it then lines with a mixture of slime and earth. "When it has succeeded in bringing the aperture of the shell to nearly a horizontal position, it stops. The foot is soon contracted within the shell, the snail then expands so as to completely cover it; the collar of the mouth, which is at this period very white and thin, inspires a quantity of air, after

which it closes the respiratory hole. When this is done, a fine transparent membrane is formed with its mucus, and interposed between the mantle and any extraneous substance lying above. The mouth then secretes a quantity of very white fluid over its whole surface, which sets uniformly like plaster of Paris, and instantly forms a continuous covering about half a line thick. When this is hardened, the animal separates its mouth from it by another and stronger mucous secretion; and after a few hours, expelling a portion of the air it had previously inspired, it is enabled to shrink a little farther into its shell. It now forms another lamina of mucus, whence more air, and then retires farther into the shell; in this way sometimes a fourth, fifth, or even a sixth partition is formed, with intermediate cells filled with air."* The process occupies about three days, and when it is finished the snail becomes quite torpid, and ceases to breathe. With the warmth of April it awakes, and gradually breaks its way out, inspiring while doing so the air which its instinct had taught it to store up for this very purpose.

There is a little condylope called the pest of the perch, which is found in fresh water. When hatched, it is led by its instincts to wander about until it finds the mouth of a perch, into which it enters and fastens itself. Here it dwells, holding firmly on, sometimes to the palate and

* Penny Cyclopædia, quoting Gaspard.

sometimes even to the tongue, and maintaining its grip so fast that it cannot be removed by force without rupturing its arm-like suckers. That this little parasite should seek out a fish's mouth for a habitation, and not any fishes, but only that of one of two species of perch, is a very singular instance of an instinct. To make the matter still more remarkable, there is a species of small mite which seeks out the pest of the perch, which, when it finds, it fixes upon and there resides.

An amimal low in the scale, a kind of crab, constructs burrows in the sand in which to dwell during the winter. It is much preyed upon by numerous animals; and, to protect itself, is led by its instinct to fortify itself by closing up with sand the entrance to its subterranean abode. When the increasing warmth tells it that the spring has returned, it reopens its connection with the external world. A nearly allied species, the hermit crab, has a still more remarkable instinct. A great portion of it being undefended by any external crust, it obtains possession of the shell of some other animal, suited to its size, and dwells in it, constantly carrying it about. These hermit crabs are said to leave the shell at the time of their moult, and to seek for bigger ones suited to their increased size.

This moulting, which all crustaceous animals perform *from time to* time, is in itself a curious instinct. Crus-

taceous animals live several years, and continually go on increasing in size (unlike the insects, that never grow any larger,) and consequently the horny case which has been formed for their protection becomes too strait for them. Reaumur carefully observed this operation in the crayfish, which appears to shed its shell annually, and commonly about the end of summer. The animal fasts for a few days previously, and then returns to some place of seclusion, where, by means of puffing itself out, and then contracting itself, it gradually contrives to split its old envelope, out of which it writhes itself. That it should fast, should retire to a place of safety, and perform these contortions, are all clearly instinctive.

Some indications of instinct witnessed in a class of animals usually considered insects, although they are not—the spiders—may perhaps not inappropriately conclude this chapter. And nothing probably can better suit our purpose than Evelyn's account of his observations of the hunting spider.

"Of all sorts of insects there is none that has afforded me more divertisement than the *venatores* (hunters), which are a sort of *lupi* (wolves), that have their dens in rugged walls and crevices of our houses; a small brown and delicately spotted kind of spider, whose hinder legs are longer than the rest. Such I did frequently observe at Rome, which, espying a fly at three or four yards' distance

upon the balcony where I stood, would not make directly to her, but crawl under the rail till, being arrived at the antipodes, it would steal up, seldom missing its aim; but if it chanced to want any thing of being perfectly opposite, would at first peep, immediately slide down again, till, taking better notice, it would come the next time exactly upon the fly's back; but if this happened not to be within a competent leap, then would this insect move so slowly, as the very shadow of the gnomon seemed not to be more imperceptible, unless the fly moved, and then would the spider move also in the same proportion, keeping that just time with her motion as if the same soul had animated both these little bodies; and whether it were forwards, backwards, or to either side, without at all turning her body, like a well-managed horse; but if the capricious fly took wing and pitched upon another place behind our huntress, then would the spider whirl his body so nimbly about as nothing could be imagined more swift, by which means she almost always kept her head towards her prey, though to appearance as immovable as if it had been a nail driven into the wood, till by that indiscernible progress, being arrived within the sphere of her reach, she made a fatal leap, swift as lightning, upon the fly, catching him in the pole, where she never quitted hold till her belly was full, and then carried *the remainder* open."

Another class of spiders are not hunters, but weavers, and entangle small insects in the nets that they construct for the purpose. These weaving spiders, as is very familiarly known, put together, under the guidance of their instinct, webs, among the lines of which flies, &c., become trapped.

CHAPTER III.

THE INSTINCTS OF INSECTS.

THE instinctive arts of insects have been more attended
o than those of any other class of living beings. This
as happened from two circumstances: first, because
heir actions are principally performed upon land, and
ear the dwellings of man, and not in obscurity, or in the
ean, as almost all those previously noticed are; and, in
he second place, because all the actions, or nearly all
he actions, of insects are wholly and purely instinctive,
nd in no degree mixed up with reasoning and expe-
ience, as we will soon find is the case with animals
igher in the scale than they are. And, of all insects,
one exhibit such wonderful indications of instinct as
hose that live in societies do, and therefore as full an
ccount of them as is consistent with the plan of this
ttle book will be attempted.

Of those insects that live together in societies, not
he least interesting are the ants, large colonies of whom

live together in nests or ant-hills. These societies consist of females, males, and neuters, the last of these doing the work. Generally, in each nest, several females or queens live together, between whom the greatest harmony seems to prevail. Some time before any of these lays her eggs she is actuated by a strong desire to leave the ant-hill and escape from her palace—a desire, however, which she is prevented from carrying into effect by the neuters, who, upon such occasions, hold them firmly by the legs, and never quit their royal mistresses. They treat them, nevertheless, with great kindness, assiduously feeding them, and conducting them to that part of the habitation where the temperature is most suitable to them. By degrees this desire of the queen to quit the nest disappears; and when she begins to lay, by a most remarkable instinct she cuts off her own wings, and determinedly settles to her domestic duties. She is still, however, constantly waited upon by one ant, who appears to be ready in case she should require any thing. This attendant is from time to time relieved by another, who takes his place. When the queen has laid some eggs, the honour in which she is held is still further increased; all the ants of the colony come to present their respects to her, and to offer her food. If she desire to pass along a steep *bit of the* dwelling, they press to assist her, and some-

times altogether carry her, a number of others attending and shewing their joy by dancing around her. And if she chance to die they still treat her corpse with respect, and often for months continue to brush and lick it.

As soon as the queen has laid her eggs, some of the working ants seize them, and carry them in small parcels until they obtain a heap, which is deposited in an apartment for the purpose. Until these eggs are hatched the attention of the workers to them is incessant; according to the temperature, they remove them from one part of the nest to another, and sometimes brood over them, as if to communicate warmth to them. When the eggs hatch, and the grubs appear, their labours and cares become even more severe. Every evening, an hour before sunset, they carry the whole brood down to cells situated deep, and where they will be protected from the cold. Every morning, unless the day prove wet (in which case they allow them to remain below), they replace them in a higher part, and the period at which they do this is entirely regulated by the rising of the sun.

The labour which the workers expend in feeding these grubs is very great, the young animals being very voracious, and requiring several meals in the day. Their sustenance is derived from the half-digested food of the ants themselves, who disgorge it into the mouth of their

young, the latter eagerly stretching out to receive it. They also pay great attention to keeping the grubs clean and tidy, and are perpetually licking them and rubbing them with their mandibles. When the grubs become pupæ, and surrounded by a cocoon, they still require feeding, and they are still removed every night and morning. All this is performed by the working ants, excepting in the case of a new colony being founding, in which their number is small, in which case the queen casts aside her dignity, and acts as a nurse to her progeny.

Contrary to what happens in other insects, the young ant, when it has attained the perfect form, is not strong enough to burst its cocoon. By a most wonderful instinct, the workers know when this time has arrived. A great bustle then prevails in the apartment: three or four of the ants surmount the cocoon, and pull off a few threads; they then carefully cut an orifice sufficiently large to abstract the young ant, an operation which they perform with great caution. The next step is to remove the pellicle, which still surrounds the young animal. This done, the workers carefully feed their newly-born step-children, conduct them up and down the colony, to show them, as it were, the paths and roads; and, when the time comes for them to swarm and depart, they accompany them a little way, feed them for the last

time, caress them, and even when they have gone, they linger a little over the parting scene, as if indulging in a refined grief at the loss of those for whom they have laboured so kindly and assiduously, and whom they will never more see.

Besides attending to the young, the working ants are very busily employed in forming and keeping in order the streets, galleries, and apartments of the colony. Different species of ants vary in the manner in which they instinctively construct their habitations, although all display great adaptation of means to ends. They may, in this respect, be arranged into masons, carpenters, and weavers. The common red ant of our woods belongs to the first of these, although the outside of the hillock is composed of wood, bits of straw, or any thing of that nature that the insect can get at. The interior is composed of a number of small apartments, arranged in separate stories, and communicating with one another by means of galleries. Some of these stories are considerably elevated above the surface of the earth, while others are very deep; the object apparently being, that the workers may have choice of varying temperature in which to put the young. All this is constructed of earth; other galleries lead to the outside, but these are shut at night, when all the ants retire to repose save a few sentinels, who are stationed by the gate ready to

give the alarm to the sleepers in case of danger. When it rains, the ants close their outer doors with pieces of wood, leaves, &c. Another ant, the *Formica brunnea*, may be said to be a bricklayer. It constructs its nest in a great many stories, sometimes as many as forty, of which the half are above the surface, and the other half below. In the construction of these it employs clay, which it scrapes from the bottom after it has been a little moistened by a shower. Each ant brings a particle of this clay between its mandibles, with which it spreads and moulds it to the shape that is requisite. Each story contains large saloons, smaller apartments, and communicating galleries, and the larger rooms are strengthened and prevented from falling by means of pillars and buttresses. So skilfully and industriously do these ants work, that they can finish a whole story, with its apartments and streets, in eight hours. This ant has been noticed to work generally at night. Among the carpenter ants, the most conspicuous place belongs to the black emmet, which is not uncommon in old oak and willow trees in this country. It gnaws the wood into a great many horizontal stories, the ceilings and floors of which are about six lines apart, and the former are supported by partitions and pillars. In some manner unknown, this ant paints or stains its house black. No weaving or manufacturing ant exists in this country; but in New South

Wales there is a variety that construct their nests of leaves, which they fasten together. Sir Joseph Banks, when watching this animal, saw thousands uniting their strength to hold down a leaf; and, when he disturbed them, he was amazed to see the leaf spring up with a force much greater than he could conceive them able to conquer by any combination of strength.

But the internal economy of the ants is still more surprising. They have the power of making instinctive signs and motions, which are instinctively interpreted by their neighbours; and in this manner pretty complex pieces of news are communicated from one to the other. Strange as this seems, there is no doubt of its being the case. If those at the surface be alarmed, the intelligence is at once transmitted to those in the interior, and the larvæ and pupæ are immediately carried to the lowest apartment, as being the place of greatest security. Indeed, some species regularly post sentinels; and two species, whose war expeditions will soon be noticed, send out spies to collect information. These explore the country, return to the nest, and then, if their report prove favourable, the army sets out on its invasion; and during the campaign messengers or aides-de-camp are continually passing, evidently bearing communications from the front to the rear. Nay, if the invaders find the resistance that is made too much for them, they despatch couriers to

their nest for reinforcements, which are invariably sei immediately. Huber, to whom we are indebted for th greater part of our knowledge regarding the habits (ants, observed, that when he disturbed those that wei at the greatest distance from the rest, that these ra towards the others, struck their heads, and communicate the danger. Upon this the working ants prepared fc resistance, while the queens and males (both of whic are timid creatures) ran and hid themselves. A curiou experiment, bearing upon this point, was performed b Gould. He put a colony of ants into a flowerpot, whicl he kept surrounded by water, and thus prevented th ants from leaving it. In a few days, he put thread from the upper part of the flowerpot to beyond the water. This bridge was soon detected by one of the ants, and the intelligence instantly communicated to the others, and in a short time the threads were covered with busy labourers passing to and fro.

In making these communications together, ants* do not employ sounds. When one wishes to give another intimation of danger, it strikes its head against its neighbour's trunk; but the antennæ appear to be princi pally employed for the purpose. The military ants, for example, give the signal to march to one another, by touching the trunk with the antennæ, and the spies

* Kirby and Spence.

aides-de-camp, in some way or other, communicate
ir messages by blows with the antennæ.

ants are armed with very formidable weapons of
nce. Their mouth is furnished with two strong
ndibles, and they have a poison-bag which secretes
irritating substance, called by chemists formyle, and
ch, when combined with chlorine, gives us the
y useful anæsthetic agent, chloroform. When their
my is beyond the reach of their mandibles, they eject
formyle upon him. Thus weaponed, the working
s, or rather the neuters (for some species of neuters
very lazy), are extremely pugnacious. Not that
se of one nest fight among themselves; for, on the
trary, in the same colony the best understanding
as to prevail. The only exception to this rule that
been noticed, occurs among the red ants. A
mber of these may sometimes be seen to attack an
and tear it to pieces, or cut its head off. Some
e supposed that this proceeding is not the con-
uence of a quarrel, but because the ant has some
ase; while others imagine that it is a police en-
ement, and that the decapitated ant has been
mitting some sin. "If," says an old writer, "they
any one idle, they not only drive him without food,
purious, from the rest; but, likewise, a circle of
anks being assembled, they cut off his head before

the gates, that he may be a warning to their children not to give themselves up, for the future, to idleness and effeminacy."

Much more serious encounters take place between different colonies of the same species, the cause of battle in such cases being usually territorial; although war is sometimes entered into for the possession of *aphides* (for what use will soon be mentioned), or even for a dead fly, or a quantity of bits of sticks. In such cases, the fighting men from each encampment leave their nests, and meet midway between their respective habitations. The ants range themselves upon elevated summits, and the opponents lay hold of one another, wrestle, bite, and eject their formyle. If an individual on one side appear to be getting subdued, others of his party come to his aid. The utmost fury is excited: in many of the combats, one of the parties is put to death on the spot, and in others, the vanquished are made prisoners, for the purpose of being taken to the enemy's camp, and there killed and eaten; for in these wars the ants are perfect cannibals. As night comes on, each party returns to its nest, but at daybreak they both march out to resume the contest, and continue so to do until rain fall, which appears to have the effect of subduing their violent passions. The appearance *presented by* these contending colonies is said to be

ry astonishing. The field of battle is seldom more
an a yard square; it is covered with dead bodies, and
e living are all engaged in the most fierce and deadly
ombat, and, notwithstanding the confusion and the
xcitement, never mistaking a friend for an enemy. In
he meantime, the work of the nest is duly performed,
nd those that are left behind for that purpose, execute
eir work with due philosophy and composure; and
othing can be observed to be the matter there, save
e occasional visit of an aide-de-camp, and the conse-
ent despatch of a reinforcement.

Sometimes wars take place between ants of different
ecies. In such cases, it would seem that the larger
nerally attack the smaller, although their bullying
tentions are often defeated. Campaigns of this kind
ve been observed for many centuries. One of them
recorded by Olaus Magnus to have taken place in
weden, in which the small ones succeeded in beating
eir adversaries, and in which he declares, that the
nquerors buried the bodies of their own party, but
ft the corpses of their larger opponents to perish with
rruption, or to be consumed by birds. However this
ay be, there is no doubt of such battles, several of
hich have been witnessed by Huber. He relates
at the big ones generally attempt to attack the small
surprise, and, seizing them by the upper part of

their bodies, strangle them. If, however, the small ones have time to foresee the assault, they frequently assemble together in such numbers as to master, and either kill or take prisoners, their gigantic adversaries. If the smaller ones decide that resistance will be unavailing, they desert their nest, and seek other and undisturbed quarters. They do so with order and decorum, and the retreat is covered with large rearguards, which often succeed in making captive, or in cutting off parties of their invaders.

What follows with regard to the wars of the ants is so amazing, that had it not been observed, beyond the possibility of a doubt, it would appear a wild fable. Certain species of ants undertake warlike excursions against other species, not for the purpose of obtaining territory or *aphides*, but to make slaves, whom they carry off with them, and compel to do their menial work. There are two kinds of ants that are guilty of those kidnapping atrocities, the *Formica rufescens* and the *Formica sanguinaria*. Neither, however, are so barbarous as man; for they do not steal their victims when they have obtained adult age, but they only take the larvæ and pupæ, whom they bring up and train to serve them.

The rufescent ants make their sallies at from two to five in the afternoon, and generally a little before five.

They first send out scouts, who, as before mentioned, communicate the intelligence they have picked up to the others, by means of their mandibles. When the expedition is determined upon, the signal for advance is given, and every thing, although there is no leader, (Solomon's account, "no captain, overseer, or ruler," being literally true,) with order. An advanced guard of eight or ten precedes, but these are continually being relieved; those who have been in the advance wheeling round in a semicircle to the rear, one object of the proceeding being, probably, to communicate intelligence.

These predatory excursions are chiefly directed against the young of the black or negro ant. The rufescent ants seem to trust to carry their object by a *coup-de-main*, and sometimes go in small bands. As soon as they come upon a negro settlement, they dart upon it, and, notwithstanding the gallant defence of the sentinels at the gate, almost always succeed in overpowering them, and driving the remainder of them, and the other inhabitants of the nest, into the lowest stories; while the more advanced are engaged in this, the others make with their mandibles a breach in the walls, and the warriors entering by it, each seize a larva or pupa. When they have obtained their spoil, they return home in triumph.

Sometimes, instead of the black ant, they attack

another species, the *Formica accumularia*, and attempt to trepan its young. This kind, however, is more courageous than the black ant, and makes a determined, and often successful resistance; and it is probable, that it sometimes regains its stolen progeny. In all these attacks, a number of the besieged may be seen attempting to escape, and carrying away the queen and the young ones; and after the spoil has been taken away, the gates are barricaded, and a large body of sentinels stationed, as if in apprehension of a renewed attack.

The *Formica sanguinaria*, or sanguine ant, is another species that makes slaves. One of their expeditions was observed by Huber. At ten, in a July morning, he noticed a small band of them emerge from their nest, and march rapidly towards a nest of negroes, around which it dispersed. A number of the blacks rushed out, gave battle, and succeeded in defeating their invaders, and in making several of them prisoners. Upon this, the remainder of the attacking force waited for a reinforcement. When this came up, they still declined further proceedings, and sent more aides-de-camp to their own nest. The result of these messages was a much larger reinforcement; but even yet the pirates appeared to shun the combat. At last, the negroes marched out from their nest in a phalanx of about two feet square, and a number of skirmishes began, which soon ended in a general melée.

Long before the event seemed certain, the negroes carried off their pupæ to the most distant part of the nest; and when, after a longer encounter, they appeared to think further resistance vain, they retreated, attempting to take with them their young. In this, however, they were prevented, and the invaders obtained possession of their nest and the booty. When they had done this, they put in a garrison, and occupied the night and the succeeding day in carrying off their spoil.

The fact is, that all ants are not industrious, and the slave-making ants in particular are excessively lazy; and the end of these instinctive moments by which they take these prisoners, is to get servants who do all the hard work, make the dwellings and keep them in order, collect the food, attend upon the queens and young, bring meat to their masters, and also actually carry them about the nest upon their backs.

So dreadfully idle, indeed, are those rufescent ants, that if left to their own resources they will rather starve than procure food. Huber shut up in a box about thirty of them along with some pupæ of their own kind, and some negro pupæ, and in a corner of the box he also placed some honey. At first the ants did take the trouble to move the pupæ a little about; but th y soon determined that they were far too dignified to feed themselves. In two days most of them died, apparently

from want of food, and the remainder looked extremely weak and languid. Huber then introduced a negro ant, which immediately set to work, dug a cell for the young, in which it placed them, assisted the larvæ about to be developed, and fed the surviving rufescents.

The sanguine ants are not quite so indolent, for they may be seen assisting their negroes in house work; and, moreover, when danger attacks the colony, they place their servants in the place of greatest security, and then prepare to defend them. Sometimes, indeed, the rufescent ants take a fit of industry, and have been noticed, when they wish to migrate, to take their slaves, and, instead of being carried, carry them to their new abode, which, however, they compel the poor blacks to construct.

Another instinct of the ants which, although it has been questioned, seems certain, is their making a property of, and keeping as domesticated animals, *aphides*. A saccharine juice exudes from these animals, and passes out by two tubes or nipples. When no ants are near them, this trickles out and is wasted; but the ants when present, and when the saccharine liquor is about to escape, apply their mouths and suck it in. But this is not all: by means of their antennæ they rub the sides of the aphides, and cause the juice to exude at will, or, to use the expression of Kirby, the ants *milk the aphides*. Sometimes a particular colony of ants lay

claim to all the aphides on a plant or tree, and, if any stranger ants come near, attack them with great ferocity. At other times, again, they enclose the aphides for security in a tube of earth placed near their nest. But the yellow ant adopts the most extraordinary expedient. It takes the aphides into its own nest, and carefully feeds it with grass. It is a breeder of its stock, too; it takes great pains to spread in the sun the eggs that the aphides lay. Occasionally the inhabitants of one nest make a foray for the purpose of stealing the aphides of another, and when this is the case a very bloody battle is the result.

Emigrations sometimes take place from an ant-hill, during which curious instances of instinctive movements may be observed. The following is Kirby and Spence's very graphic account of the manner in which these are managed:—"Some of the neuters having found a spot which they judge convenient for a new habitation, apparently without consulting the rest of the society, determine upon an emigration, and thus they compass their intention. The first step is to raise recruits; with this view they eagerly accost several fellow-citizens of their own order, caress them with their antennæ, lead them by their mandibles, and evidently appear to propose the journey to them. If they seem disposed to accompany them, the recruiting officer, for so it may be called,

prepares to carry off its recruit, who, suspending hims upon his mandibles, hangs coiled up spirally under l neck. All this passes in an amicable manner, aft mutual salutations. Sometimes, however, the recruit takes the other by surprise, and drags him from the ai 'ıill without giving him time to consider or resist. Wh arrived at the proposed habitation, the suspended a uncoils itself, and, quitting its conductor, becomes recruiter in its turn. The pair return to the old ne and each carries off a fresh recruit, which, being arriv at the spot, join in the undertaking; thus the numb keeps progressively increasing till the path betwe the new and the old city is full of goers and comers, ea of the former laded with a recruit. What a singular a amusing scene is then exhibited of the little people th employed! When an emigration of a rufescent colo is going forward, the negroes are seen carrying th masters, and the contrast of the red with the black rend it particularly striking. The little turf ants, *F. caspitu* upon these occasions carry their recruits uncoiled, wi their heads downward and their body in the air.

"This extraordinary scene continues several days; t when all the neuters are acquainted with the road to t new colony, the recruiting ceases. As soon as a s ficient number of apartments to contain them a *prepared, the* young brood, with the males and femal

are conducted thither, and the whole business is concluded. When the spot thus selected for their offspring is at a considerable distance from the old nest, the ants construct some intermediate receptacles, resembling small ant-hills, consisting of a cavity filled with fragments of straw and other materials, in which they form several cells, and here at first they deposit their recruits, male, female, and brood, which they afterwards conduct to the final settlement. These intermediate stations sometimes become permanent nests, which, however, maintain a connection with the capital city.

"While the recruiting, is proceeding, it appears to create no sensation in the original nest; all goes on in it as usual, and the ants that are not yet recruited pursue their ordinary occupations; whence it is evident that the change of station is not an enterprise undertaken by the whole community. Sometimes many members set about the business at the same time, which gives a short existence (for in the end they all reunite into one) to many separate formicatories. If the ants dislike their new city, they quit it for a third, and even for a fourth; and, what is remarkable, they will sometimes return to their original one before they are entirely settled in the new station; when the recruiting goes on in opposite directions, and the pairs pass each other on the road. You may stop the

emigration for the present, if you can arrest the fi recruiter and take away his recruit."

Another insect that lives in societies, and that affor us many indications of instinct, is the wasp. A fi colony of wasps consist of males, neuters or worke and two kinds of females, one a large kind, which la both male and female eggs, or a queen, and the oth not bigger than a worker, and which only lays ma eggs. All these, except a few females, are killed by t cold of the beginning of winter. These few femal remain torpid until the return of spring, when t warmth resuscitates them, and each flies off alone form a colony. Unassisted, and directed by her instinc she erects a small house, often in the nest of a fiel mouse, and at other times in a cave which she h laboriously excavated, in which she deposits her egg When these are hatched, she assiduously feeds h young until they attain maturity. Three other broo are successively born; but the queen-mother is not a longer under the obligation of labouring herself, and h children faithfully execute all the labour of the nest. by some accident, before any more females are hatche the queen be destroyed, all the neuters lose their instinct cease to work or gather food, and consequently perish.

The male wasps are smaller than the females, b *larger* then the neuters. Unlike bee drones, immediatel

to be noticed, they are active and industrious. They act principally as scavengers, sweep the streets and passages of the nest, and carry away any dirt. If any of the wasps die, they also remove the body, and conduct the funeral. In consequence, doubtless, of their utility, the other wasps are not instinctively led to destroy them, as these do drones; but, on the contrary, the workers who collect all the food faithfully give the due share of this to the male wasps.

These workers are the wasps that come to our houses, and annoy us by their robberies and their stings. Nothing comes amiss to them; fruit, preserves, meat, and they greedily attack flies and other insects. The food that they obtain appears to undergo a partial digestion; they then return to the nest, where each of them is surrounded by a number of queens, drones, and of workers, who have been engaged in the nest in building, mounting guard, &c. Each of these returned workers then disgorges a drop or two of this same digested food, which is swallowed by one of those who surround it, then another drop, which is taken by another recipient, and so on. When the food that they have obtained is the body of an insect, as a fly or a bee, they do not swallow it, but carry it home entire.

When the cold weather begins, a most astonishing indication of instinct may be witnessed in the nests of

these sociable wasps. They at other times appear have the greatest affection for the young; but after t first frosty night, they drag all the grubs out of th cells and mercilessly destroy them. The end obtain by this summary proceeding is doubtless the saving t grubs a lingering death from the cold.

The extending the nest from the foundation laid l the queen-mother, until it can contain thirty thousa or more inhabitants, that a colony sometimes numbe gives constant employment to a great number of t workers. The nest of the common wasp, as before me tioned, is usually situated under ground. It is of oval shape, and is about eighteen inches long, and twel broad. The outside is composed of several (fifteen sixteen) layers of a grey paper. These layers are n placed close together, like the layers of a piece of past board, but with intervals between each; the object this instinctive mode of building being to prevent t rain from penetrating. The interior of the nest consis of twelve or more circular combs, arranged in parall stories, each of which is composed of a number of hex gonal cells, made of the same kind of paper or papie machée as the internal covering.

Wasps are taught by their instincts, also, to pla sentinels at the entrance to their nests, and, if these ca *be suddenly* surprised, the remainder in the nest do n

come out and attack the invader; but if the sentinels be allowed to give the alarm, all the workers come out ready to do battle.

Humble bees also live in societies. The name is given to them owing to the loud dull hum that their workers make when flying, but they really are humble or homely creatures, and appear to be the most rustic of all the *Hymenopterous* societies. Unlike the wasps, they store up both honey and wax, but, unlike the bees immediately to be brought under our notice, they are not instinctively profound mathematicians, but construct their abodes in a clumsy and village-like fashion. They seem, too, to be of a credulous and soft disposition; and honey bees can wheedle them out of the honey that they have gathered, although they refuse to part with it, or seek refuge in flight, when wasps make similar overtures. Humble bees have actually been known to permit bees to take the whole honey that they have collected, and to go on gathering more, and handing it over, for three weeks.

A nest of humble bees consists of large queens, small females, males, and workers. The large females are hatched in the autumn, and pass the winter in a state of hybernation, in a little apartment that they have instinctively prepared and lined with moss and grass, near the nest. Very early in spring the queen-founder awakes, constructs cells, lays eggs in them, gathers food,

and feeds the young grubs when hatched. So energe is she as an architect, that she can construct a cell in short a space of time as half an hour, although quite u aided, and, of course, without any aid from previous ex rience. Her family and subjects at first consist of worke which are born in May and June; afterwards males a females are hatched, and it is noticed that the young these are instinctively fed with a different kind of fo from the young of the workers: the grubs that are goi to be workers, receiving a mixture of honey and poll while those that are going to be drones and queens, ceive pure honey only.

Very singularly, the queens in the autumn, althou they collect honey and make themselves useful, never co struct cells; and it is only when they arouse themselves the spring, that this instinct of building is developed a in force. In like manner also, in the autumn, they, a the small queens who are destined to become the moth of the drones, are no ways jealous of one another, althou in summer time the antipathy that the queen-mot shows to the latter is very great. Indeed she dri them as much as possible from the cells, and destroys she can, all the eggs that they have deposited in the

The male of the humble bee is industrious, and assi in making and repairing the nest; but it is upon t *workers*, or neuters, that the principal part of the labo

falls. They, as soon as they are brought into being as perfect insects, begin and construct the vault that covers and defends their nest; they go about collecting honey; and they are born with the curious instinct of making an aperture in the base of the corolla of a plant, so as to get directly at their food, when they cannot enter by the expanded flower; they feed the young grub, and when it has become a perfect humble bee, they store up the cell that it had occupied with honey.

The honey or hive bee, however, is the insect that affords the most complicated observed indications of instinct; and although these have been so often described that they are familiar to most people, the instinctive movements of bees are so complex and so clearly the result of instinct, and not reason—the bee just brought into life possessing them as well developed as an old bee—that it is impossible in any work having a reference to instinct to pass them over.

A hive of bees consists of one queen, several hundred drones, and many thousand neuters, or working bees, all differing from the other in size and appearance. They also differ in the period that they take from the time that the egg is laid to their becoming perfect insects. Thus the queen passes sixteen days in the preparatory stages; three days the egg remains unbroken; the grub, when hatched, feeds for five days more; one day is occu-

pied in spinning the cocoon; she then remains still i two days and sixteen hours, and continues as a pupa f four days and eight hours. A worker requires twen days, and a male twenty-four. These facts are give in order to render intelligible two very remarkal instincts.

A queen bee is necessary for the very existence of t hive, and yet she is so jealous of a rival that two cann exist in a hive. It sometimes happens that the que dies, and that, also, there is not in the hive a comb co taining the egg or larva of a queen. When this ca mity occurs, the bees take from a common cell a gr that would, if left in that cell, have turned out a work and the grub they instinctively fix upon is never m than three days old. This they place in a royal c to do which they mercilessly destroy the surroundi grubs; and during the days that it requires sustenan a bee incessantly watches over it, and feeds it with ro food; the result of this treatment being, that it is veloped into a queen, and has a totally different structu and totally different instincts, from what it would ha had if it had not been so treated. This, however m vellous, is an undoubted fact, and it is brought forwa as affording indication of two instincts. The one is t complex movements which the bees take when depriv *of their queen,* in order to obtain a new one, althou

they cannot know why they are thus acting. The other is, their always fixing upon a grub three days old. The bees cannot know why they do this either, but we can understand the end fulfilled by it; for if we consider the length of time between the laying of the egg and the appearance of the perfect insect in the different varieties of the occupants of the hive, we see that the bees by this procedure save several days, and repair their loss and obtain a new monarch in ten days.

But the instincts that are manifested by the bees upon ordinary occasions in the economy of the hive, are as wonderful as in the above exceptional case. Not the least curious among them are those that lead them to construct their habitations. There are two, and sometimes three kinds of working bees to be observed in a hive—a black sort, that appear to be either superannuated or diseased, and which are mercilessly put to death by the others—and nurse bees and wax-makers—the last-mentioned having the power of secreting the peculiar substance that we call wax. Besides this secretion from their own system, bees gather resinous matter from trees, which, when kneaded up, is called *propolis*. With these two substances they construct their cells. When they begin to build, they divide themselves into bands; one of these produces the material, another lays the foundation of a cell, another completes it, sorts the angles, and

scrapes off superfluous wax, while one band is employed in bringing food to the labourers. The wax is used for forming the walls of the cells, and the propolis for filling up any chinks. The latter, too, is used for another purpose, which seems very like the result of reasoning, although the act is undoubtedly instinctive. If, as sometimes happens, a snail creep into the hive, the bees immediately sting it to death. The body of the snail is far too heavy for the bees to drag out; and yet, unless precaution be taken, it would putrefy, and make a stench in the hive. To prevent this, they thoroughly embalm it with propolis; and, which is even more remarkable, should a snail with a shell intrude into the hive, it withdraws its body within its shell at the first sting, and the bees, as if they knew that the shell would not corrupt, in such a case spread no propolis over the shell, but merely fasten up the orifice.

As every one knows, a number of cells are arranged together, so as to form a honeycomb. These cells are hexagonal, are applied regularly to each other's side, and are arranged in two strata, placed end to end "They are all arranged vertically, at a small distance from one another, so that the cells composing them are placed in a horizontal position, and have their openings in opposite directions; not the best position, one would *have thought*, for retaining a fluid like honey, yet the

bees find no inconvenience on that score. The distance of the combs from each other is about half an inch, that is sufficient to allow two bees busied upon the opposite cells to pass each other with facility. Besides these vacancies, which form the highroads of their community, the combs are here and there pierced with holes, which serve as positions for easy communication from one to the other, without losing time by going round."*

The manner in which the cells of the honeycomb are constructed, has long been held up as one of the triumphs of instinct. They are so shaped, as to possess the greatest stability with the least possible expenditure of wax; and in particular, and as subordinate to this purpose, the base of each cell is not an exact plane, but is composed of three pieces, so as to form a pyramidal concavity; and it is now ascertained that the angle fixed upon in this base, is exactly that which requires the least possible quantity of wax. For a long time it was thought that these angles were such as consumed *nearly* the least amount of wax; but Lord Brougham, who investigated the subject mathematically, found that it is absolutely the least, and that the instinct of the bee had all along been right, and the reasoning of the calculators wrong.

The instincts of the bee lead them to construct three

* Kirby and Spence.

different kinds of cells. Those destined for the rece of eggs that are going to be males, are much larger those intended for workers.* The cells for storir honey seem to be generally built upon the same as the preceding; but when an unusually large qua of honey is brought in, and either time or labc wanting to construct fresh cells, these are elongate the bees adding a rim to them. But the cells des for the abodes of the larvæ of the queen bees widely from the rest. They, for several of then usually constructed, are much larger than the res of a pear shape, are composed of a different kind of and at least a hundred times as much wax as v make an ordinary cell is employed for the pur Instead, too, of being horizontally situated, the placed vertically, the mouth always being downwar

Notwithstanding these cells differ according t purpose for which they are intended, and that the c are made with such apparent skill, and by such parently incapable creatures, it is unquestionably a tained that the bees do not act even in concert with another when constructing them. To use a happy ex sion, the instincts of bees in making their habita are not simultaneous, but successive. One bee do

* The cells intended for the larvæ of workers are $2\frac{2}{5}$ lines in dia *those for the drones* $3\frac{1}{2}$.

much, and when it stops, another takes up its labours, and continues them exactly in the right method; and this gives us (if indeed such were wanting, for this is clearly the case in all instinctive movements) a very good illustration of the difference between movements conducted under obedience to instinct, and those conducted under obedience to reason. In the former, there is an irresistible impulse to go through a certain series of motions after a certain fashion, without knowing why they are performed, or what their result will be. In the latter, the actions depend upon previous mental judgments, are performed or not at will, and the end of them is early anticipated and defined.

The instinctive movements of bees, in relation to one another and to their posterity, are almost incredible; but the evidence of such is unquestionable. Foremost amongst them are the proceedings of the queen-mother. Two queens cannot exist in the same hive, and if a couple of them chance to do so, either from a stranger queen coming in, or a young one being hatched, a battle is immediately fought, in which one is sure to perish. In the former case, *i. e.*, when a stranger queen is introduced into a hive that already contains one, an extraordinary scene takes place. A circle of bees instinctively crowd around the invader, not, however, to attack her—for a worker never assaults a queen—but to respectfully prevent her

escape, in order that a combat may take place between her and their reigning monarch. The lawful possessor then advances towards the part of the comb where the invader has established herself, the attendant workers clear a space for the encounter, and, without interfering, wait the result. A fearful encounter then ensues, in which one is stung to death, the survivor mounting the throne. Although the workers of a *de facto* monarch will not fight for her defence, yet, if they perceive a strange queen *attempting* to enter the hive, they will surround her, and hold her until she is starved to death; but such is their respect for royalty that they never attempt to sting her.

If the hive lose their queen, strange proceedings take place as the young queen assumes the perfect or imago state. The first one that becomes thus developed almost immediately proceeds to the royal cells, and darts upon the first that she espies. She gnaws a hole in it, through which she inserts her sting, and thereby destroys her embryo rivals. A number of workers accompany her, but do not venture to offer any opposition to her violence; and indeed, after the murder is committed, they enlarge the breach and extract the dead body.

It sometimes happens that two young queens attain perfection at the same time, and in such a case they *afford indication* of another and very peculiar isntinct

At first the instinct of fighting prevails, and they dart upon one another with a fury that seems to threaten death to both, and head is opposed to head and sting to sting. But the moment that they come into this position, a sudden panic seizes them, and both fly. They soon return, and the same scene is repeated over and over again, until one young queen in the advance seizes the other by the wing, and then inflicts a mortal wound. By this instinct the two do not perish, and thus the hive is prevented from wanting a queen. All this is performed before they are perhaps five minutes old.

The workers, however, do often prevent the queen from attacking and destroying the royal grubs; but this is only before she has come out of her cell and assumed authority. They keep her confined until she is perfectly able to lead a swarm; and, even when they do let her out, they hinder her from destroying her immature royal sister, a proceeding she is much bent upon. She then becomes violently agitated, and inclined to lead a swarm, the members of which follow her. This proceeding only takes place in full hives; and when the hive is thin in numbers, and it is not desirable to send out new colonies, the workers let the queens destroy one another, as before mentioned.

If the queen die, or be removed from a hive, the population do not appear to discern their loss for about an

hour. At the expiration of this time a degree of re lessness begins to manifest itself; the bees run to and f and those that first begin to do so, strike the others w their antennæ, and apparently communicate the news a disorder. All soon becomes in a very confused sta work is neglected, and the bees continually pass in a out of the hive. The tumult lasts for some hours, af which the bees become quiet, and proceed to fill some of t cells with jelly, and, as before mentioned, rear up neu larvæ into queens. If, however, the queen be restored them, their joy is excessive, and manifested.

Another remarkable fact connected with the instin of the bees is, that the queen sometimes, apparen from disease, becomes incapable of laying eggs that v turn out workers, all the eggs that she does lay hat ing into drones. When this is the case she loses t propensity to attack other queens: in this manner community is not suffered to die out for want of n labourers; and yet her subjects in no degree dimin their respect to her.

The drones are, in ordinary cases, put to death by t workers when they are about two months old. Tl they do by stinging them; but in the case just me tioned, where the queen lays male eggs only, th instincts teach the workers to let the drones live—a they do not attack them.

As soon as a working bee has attained its perfect or imago state, it seeks for the door of the hive, and instantly sets out, quite capable of fulfilling all its destinies. The hum made by its wings ceases at the first flower it arrives at, into which it enters, and, rubbing its tongue between the petals and stamens, sweeps out all the nectar, which it deposits in its honey-bag. When, having passed from flower to flower, this honey bag is full, it takes from the anther the pollen necessary to make the bread for the pupæ, and it also gathers propolis. It will have flown, perhaps, a mile before it has got laden. It then returns uniformly in a straight line to its hive. Arrived there, it imparts to its comrades, who have been engaged at home, what nutriment they require, and stores up the rest for after use. It then rests for a few minutes, and again departs on its food-collecting errand. In like manner it arrives into being, perfectly able to perform all its other instinctive actions without requiring the slightest education.

Perhaps not among the least surprising of these, are the contrivances of the bees for ventilating the hive. A bee-hive, as may easily be fancied, is apt to get both heated and corrupted by foul air. In order to obtain a supply of fresh and pure air, a number of the workers, often about twenty, station themselves in a file upon the floor. They hold very firm to the ground, and "by

means of their marginal hooks, unite each pair of wing into one plane, slightly concave, thus acting upon the ai by a surface nearly as large as possible, and forming fo them a pair of very ample fans, which in their vibration describe an angle of 60°." They vibrate these fans with such rapidity, that the wings are scarcely visible. By this operation, a very perceptible current of air is driven into the hive, which of course displaces the corrupt air.

The warlike undertakings of bees are amusing Dreadful deeds are sometimes to be witnessed in a hive and probably depend upon one of the workers having become old and not so active as before, and another one trying to kill him. These encounters occasionally end in the death of both combatants; sometimes one slays the other, and sometimes, after fighting for an hour or more, they give up by mutual consent. Occasionally general battles take place between the occupants of two hives. A hive may attempt to plunder the honey of another, and, when this is the case, the bees composing it at first act with caution, and a few of them linger about the door of the hive intended to be pillaged. After a little the whole robbers come in a body, and a fearful battle ensues. If the invaders can succeed in killing the queen, the attacked join with them, assist in plundering their former house, and then depart home *with the* robbers.

Occasionally four or five bees unite together, and attack either a straggling hive bee or a humble bee. Their object is merely to rob him of his honey. They hold him by the legs and pinch him until he unfolds his tongue, which is sucked in succession by his assailants, who then suffer him to depart in peace.

On the other hand, bees are themselves exposed to many assailants. The common wasp often attacks their hives on a pilfering expedition, and, owing to his size and courage, is a formidable thief: one wasp being able to fight three bees. On some occasions the wasps drive the bees out bodily, take possession of their hive, and, of course, eat all their honey. A still more formidable opponent is found in the larvæ of *Tinea mellonella*, and other species of moths, who spend the early part of their lives in the hives, where they consume large quantities of food. They spin a silken tube around them, through which the stings of the bees cannot penetrate. The bees, however, take great pains to keep the moths out of their hives, and thus prevent the possibility of their laying eggs in them.

They put sentinels at night, who, on the approach of the moth, utter a low hum which brings assistance, and the moth is stung to death. The death-hawk moth, which is almost as large as a common bat, sometimes makes its way into hives, where it commits great havoc. To

defend themselves against it, the bees barricade entrance of their hives with a strong wall made of and propolis. This wall is built behind the gate which it completely stops up, and is only pierced a hole that will admit one or two workers. This tion is only put up in extreme emergencies, but striking example of an instinct.

CHAPTER IV.

THE INSTINCTS OF FISHES AND REPTILES.

Owing to reptiles being (from their cold and slimy eel) an object of disgust to most people, and owing to their lives being in part, and those of fishes altogether, passed in a different element from that which we inhabit, our knowledge of their habits and instincts is very confined. Nevertheless, the movements that they make are very complex, and serve very important ends, and they seem to be exclusively or nearly so the result of instinct, and not of experience and reason.

The instincts shewn by fishes in their migrations, for instance, are very wonderful. There is the cod-fish, so important, particularly in a dried state, as an article of food, and the fishing for which gives employment to thousands of sailors. Every winter, or at the beginning of spring, this fish, which inhabits the depths of the ocean, makes for the shore; always directing its course northwards. The mackerel, at the approach of winter,

seeks out landlocked bays in the Arctic, Antarctic, a Mediterranean seas, in the muddy bottoms of which plunges its head and the upper part of its body, a then passes the winter in a state of hybernation. the spring the mackerels emerge from their torpid stat and then they direct their course invariably south. Tl herring, too, inhabits the arctic seas, and instinctive makes immense migrations southward, being irresistib compelled to depart three times in the year; once wh the ice begins to melt in spring, again in summer, a the last time in September. The object of the migrations is to deposit their eggs in places where more genial warmth will hatch them. Another class fishes, of which we may take the salmon as an exampl spend a certain portion of the year in the ocean, a then migrate for a period to the fresh water of river sometimes penetrating to a distance from the sea three thousand miles. The salmon is a very widel distributed fish, having been found in almost every se save the Mediterranean. In temperate latitudes it leave the sea in spring, and proceeds with regularity and ci cumspection to enter the rivers. One of the largest c the band that ascends any particular river, generally female, takes the lead, and appears to direct the enter prise. She is followed by two of the same sex, an *these* by other pairs of females, each pair being at th

distance of about six feet. After these come the males in pairs, and in like order. It is a familiar fact, when they arrive at a cataract they place their tail in their mouth, and let it suddenly go out with violence, and in this manner are able to spring several feet out of the water. The pertinacity with which they repeat their leaps until they surmount the obstacle, is, as is the case with all instinctive movements,* very great. The object, or the main object of the migration of the salmon, is to deposit their spawn in the shallows of fresh water streams.

To bury themselves in the mud can scarcely be called a migration, yet doing so is an instance of an instinct; and pond fishes, as carp and tench, thus act when the heat and drought of summer threaten to dry up the water. Other pond fish are, however, upon such occasions led by their instinct to desert their native pools, and seek others with more water. Eels are a familiar instance of this; but in other countries still more remarkable examples are to be found. Thus, there is a fish called by the Indians the flat-headed hassarr, which lives in small pools that are very liable to be dried up during summer. When this danger is imminent in any particular pond, the fish unanimously desert their home, spring on the land, and, by means of their pectoral

* Thus, if an ant seize a dead insect which it cannot carry off, it does not leave its hold, but pulls until it dies of starvation.

fins and their tail, wriggle themselves along until t arrive at a pond containing water. It is believed they have some means of conveying a supply of w with them, with which they keep their gills moist, are thereby enabled to breathe. Another fish that habits Carolina, also possesses this migratory insti and was experimented upon by Bosc. He found they uniformly directed themselves towards the nea water, although they could not possibly see it. S more extraordinary are the land expeditions of a spe of perch, which not only comes on shore, but asce palm-trees in search of food. The gill-covers of this are studded with spikes, and it contrives to climb tree by sticking these into the bark alternately with spines of its fins, the one set supporting it while i advancing with the other. This perch has a contriva by means of which it can keep its gills damp.

It was formerly thought that fishes made very li or no provision for the habitation, &c., of their proge but it is now known that several species of them are by their instinct to construct nests, in which th deposit their eggs. A species of sticklebat, that is co mon on the coast of Berwickshire, has been observed Sir David Milne, Mr. Duncan, and the Rev. M. Turnb decidedly to do so. The nests of these fishes are to *found* in spring and summer, in rocky pools betw

high and low tide-mark; and are noticed to be particularly common about Eymouth and Coldingham. They are about eight inches long, of a pear shape, and are formed by matting together the more common sea-weeds. These pieces of sea-weeds are firmly tied together by means of a thread, run through, around, and among them, in every possible direction. This thread appears to be secreted by the animal. In the centre of this nest the eggs are laid, and the parent mounts guard upon it to protect it from the attacks of animals; and so intent is it upon the safety of the nest, that it will allow itself to be taken out of the water. In the Thames, too, sticklebats have been noticed to build nests, using there as materials, bits of wood and sticks, and pieces of straw. Another kind of fishes' nest is constructed of coralline, pieces of which have clearly been conveyed from a considerable distance.*

Other singular instincts have been observed in certain fishes, with regard to the manner in which they obtain their food. There is the fishing frog, for example, or the sea devil, as it is sometimes called, a very ugly inhabitant of European seas. "This fish," says Lacèpéde, "having neither defensive arms in its integument, nor force in its limbs, nor celerity in swimming, is, in spite of its bulk," (it is sometimes six or seven feet long),

* Aristotle was quite aware of this habit of fishes.

"constrained to have resource to stratagem to pro its subsistence, and to confine its chase to ambuscade which its confirmation in other respects adopts it. plunges itself into the mud, covers itself with sea-w conceals itself among the stones, and lets no part be perceived but the extremity of the filaments fringe its body, which it agitates in different directi so as to make them appear like worms, or other b The fishes, attracted by this apparent prey, appro and are absorbed by a single movement of the fis frog, and swallowed by his enormous throat, where are retained by the numerous teeth with which i secured." Another fish, the fly-shooter, adopts a more extraordinary mode of providing its food. food consists of small insects, and these it shoots, were, by ejecting a small drop of water from its mo which hits them, and makes them fall within its ran

Some fishes have the power of giving off from th selves electricity, and in this manner of killing or stun their prey. The one of these that has been most ticularly studied, is the torpedo. This fish was kn by Aristotle to possess a benumbing action upon who touched it. This is owing to an electrical ch which proceeds from a special apparatus that is prov to the animal for the purpose. The fish probably *concealed in* the mud, and, when other fishes approac

it instinctively discharges it electricity, and then takes possession of them in their benumbed condition. A duck that was placed in a vessel of sea-water in which was a torpedo, was found at the end of three hours to be quite dead. Another probable use of the electrical apparatus is, to defend its possessor when attacked by sharks or other large fishes.

Among the reptiles, there is one family that does not excite the same disgust that other reptiles do, and several members of which are used as food. These are the turtles or tortoises; and, although the habits and manners of them have been very little observed, some rather curious examples of instincts have been noticed in them. Thus the thalassian, or sea-turtle, although she lives at sea, is taught by her instinct to seek out the land, on which to deposit her eggs. To do this, she has often to travel more than fifty leagues, which she does, accompanied by her consort. She is a very unwieldy creature on the land, moving with great difficulty and slowness. She instinctively, however, crawls at any effort to above high water-mark, when she carefully scoops out a hole, lays her eggs in it, and then carefully covers them up with sand. The very moment, too, that the young turtles are hatched, they instinctively make for the sea.

These turtles are very much preyed upon by fishes,

birds, crocodiles, and man. The last-mentioned son
times makes use of the natural instincts of a fish to cat
them, this being the only instance in which a fish is us
for such a purpose. The inhabitants of China and t
Mozambique employ in this way a species of remo
This fish has a ring fastened in his tail, to which a stro
cord is attached. When the fisherman perceives a t
toise floating on the sea, he slips one of these remora in
the water, who instantly makes for the turtle, of wh
he takes a firm grip. The two are then hauled into t
boat by means of the string. The fish is then return
to a tub kept filled with water for his habitation in t
boat.

There is a reptile, a species of salamander, that pla
each of its eggs in a leaf of *persicaria*, which it prote
by doubling the leaf over it. This egg, too, is surround
by a gluey matter, which assists in securing it to
envelope. The salamander is the animal that, from t
days of Aristotle, has been reputed to have the prope
of putting out flame into which it may be thrown.
a certain extent, this is really true. The salaman
has the power of secreting from its skin a white and ve
acrid fluid, which it instinctively ejects when it desires
destroy its prey, or apparently when irritated, and t
can put out flame. Kirby was aware of a remarkal
example of this. Three ladies, living in a very dar

country-house, had their cellar very much frequented by frogs, and also by some black newts or salamanders. One day some of the frogs were caught and put into a pail. While the ladies were looking at the frogs, a salamander that was also in the pail, was noticed running amongst the frogs and touching them, and the moment it did so touch them, the frogs died. Not unnaturally, the black salamander was from that day regarded as fearfully venomous, and one of them being found one night afterwards in the kitchen, was caught with a pair of tongs and dropped into the fire, which was burning pretty brightly. Instead of being instantly consumed, the reptile slipped through the glowing coals, and escaped apparently unhurt under the fireplace. It was probably protected in its fiery ordeal by this juice.*

Serpents swallow their prey whole, and instinctively, before swallowing it, crush it with their voluminous folds, and lubricate it excessively with saliva. By obeying these instincts, a boa-constrictor can swallow animals bigger than itself.

There is a species of chameleon that can, by variously inflating its lungs, change its colour from green to dark-brown; and when lurking for its prey, or seeking security from its pursuer, it is believed that its instincts

* This anecdote is given on the authority of Kirby.—T. L. K.

teach it to modify its colour, according as it is by the side of a tree or of a rock.

The last indication of instinct that we will mention as to be noticed among reptiles, is that of the crocodile, which, when sore pressed with hunger, swallows stones to relieve the uneasy sensation.

CHAPTER V.

THE INSTINCTS OF BIRDS.

THE indications of instincts in birds that will be ıoticed in this chapter, have reference to their migra-ions, the construction of their nests, and the habits of ɔme of them that live in communities.

We may take as the type of a migrating bird, the vallow. It makes its appearance here in spring, con-ructs its nest, and hatches its young ones. In the ıtumn, it and also those young ones that are hatched this country, are led by an irresistible instinct to fly l the way to Africa. No decrease of temperature or minution of food appears to have any influence in ɛtermining this migration.* On the contrary, the ɛsire to depart, and the route taken, must be entirely ɜcribed to two blind instincts. The young swallow ɔrn in this country, accustomed to our scenery, our ıɛects, our animals, our very habitations, for its own

* The swallow is pretty indifferent to cold.

nest has been constructed against them, obeying an uncontrollable instinct of which it cannot anticipate the result, leaves all that is familiar, and crosses a vast ocean and leagues of land until it reach some African wild, with new trees, animals, insects, and perhaps men. And in a few months this same instinct makes it leave all these, retraverse the leagues of land, recross the ocean, and again approach the scene of its nativity.

We have in this country a number of birds that make partial migrations, but which do not leave the island. They merely shift their quarters from one part to another. Thus the duntin inhabits, during the breeding season, the moors of Dumfries-shire and other Scottish moors; but when the young are fledged, these birds come to the sea-shore, from whence they gradually extend over all the coasts of the island, returning next year to the Scottish moors to breed. In a similar manner, the curlew and the golden plover live in winter on the coasts, and in summer repair to inland lakes and moors. The linnet, in winter, approaches the habitations of man; the dipper, in summer, ascends the streams to their sources; and the lapwing, when winter comes on, goes north. A curious instance of this partial migration has been observed amongst the crows of Dumfries-shire; they breed in great numbers at Carruchan, in that county, *but* when their young are fledged, they leave that

locality. During the autumn and winter, however, they frequently pay a passing visit to their nurseries.

A number of birds inhabit this country during the summer only, and disappear in the autumn. With the early spring comes the wheat-ear, the whinchat, and the ring-ouzel, and, among these vernal birds of passage, the cock-birds arrive about a fortnight before the hens. A little later appear the swift, cuckoo, nightingale, &c., in all about twenty in number. White, in his delightful history of Selborne, noticed that the first visiter in that village was the wryneck, which usually appeared about the middle of March, and that the last of the summer birds of passage was the flycatcher, which generally came on the twelfth of May. He also observed that by the end of September all had disappeared.

As, however, these depart, their place is taken by the winter birds of passage, *i. e.*, by those who arrive here at the end of autumn, spend the winter with us, and depart on the approach of spring. The most abundant of these are the redwing, the fieldfare, the woodcock, the two snipes, the wood-pigeon, (so hostile to the farmer, and doing more harm to the turnips than the pheasant does to the white crops,) the widgeon, the teal, and the wild-duck and goose.

That each of these species should have its appointed reason for coming and departing to the country, and that

this season should be strictly observed by each succeeding generation, are very striking instances of instincts. They are not owing to any want of food or alteration of temperature; for they take place before the supply of food falls off, and before the weather becomes much colder, or warmer. Indeed, when there is abundance of food and a high temperature, a summer bird of passage still departs at the end of summer. The stork, for example, leaves Bagdad, where the winter is extremely mild, just at the same time that it does the fens of Holland; and, if confined in a cage, although it remains quiet for a period, yet when the appointed hour comes, it dashes itself against the bars of its cage until it beats itself to death in its struggles to obey its instincts. Birds migrate because He who made them knew, that He had so ordered matters that there generally *would* be, *by and by*, a deficiency of food and a change of temperature, and He implanted in their matter this strong but blind instinct to depart ere such supervened.

The nidification of birds affords many examples of movements that are purely instinctive, inasmuch as the young hen (the hen generally takes the principal charge in nest-building) of each species builds her nest after the right fashion, the first time as well as the last. We may begin our indications of these nest-binding instincts by considering the habits of some of the birds that make

rrows in the ground. The peterel family do this. One these, seldom seen in Europe, but familiar to every e from description, as being an object of superstitious ead to mariners—the stormy peterel, or Mother Carey's ickens—and remarkable for the bold and fearless man- r in which it hovers over the waves in the severest orm, uttering a wild cry of—*weet, weet.* It was probably e wildness of this cry, coming amongst the confusion a storm, that led sailors to conclude that the bird was some manner connected with the prince of darkness. mong other opinions held regarding them are, that no an knows where they come or whither they go, and at the female carries her egg underneath her wing, and ere hatches it. This last is of course impossible, and e truth is, that they take possession of cavities in the ck, or dig out burrows in the shore. "They make les," says Wasser, speaking of Juan Fernandez, "in e ground, like rabbits;" and father Lobat states, that he great sulphur mountain in Guadaloupe is all bored e a rabbit warren with the holes that these imps cavate."

Until lately a bird of the peterel tribe—the puffin—as very common in the Isle of Man, and is still found in Wales and other parts of the western coasts of Britain. his bird makes extensive subterranean residences. ontrary to the usual custom, the male undertakes the

greater part of the labour. He commences by scraping a hole in the sand, near the shore. When he has made a little excavation, he throws himself on his back, digs with his very broad bill, and with his webbed flat foot casts out the rubbish. In this way he succeeds in making a burrow, with several windings and turnings, and about ten feet deep, where his mate can hatch and bring up her young brood in comparative safety. It is said to sometimes save itself trouble, by taking possession of the burrows of a rabbit.

Another bird that inhabits our island—the beautiful kingfisher—excavates itself a home in the ground. It selects as the scene of its operations the bank of a river. Then it excavates about three feet deep, the direction of the hole being diagonally upwards, and the inside is much wider than the opening, in order probably to give the bird room to turn.

Another class of birds are called, from the manner in which they construct their nests, mason birds. The nuthatch, or *pic maçon* of the French, is one of these. It fixes upon a hole in a tree for its habitation, but it puts up a barricade of plaster at the opening, merely leaving a hole large enough for its own ingress and egress, and thus keeps out intruders. If this wall be pulled down, it is immediately rebuilt. The house martin, too, is a *familiar* example of a mason builder. Mr. White's account

f its proceeding in this respect has become classical. About the middle of May," he says, "if the weather be ne, the martin begins to think in earnest about providng a mansion for its family. The crust or shell of this est seems to be formed of such dirt or loam as comes ost readily to hand, and is tempered and wrought ogether with little bits of broken straws, to render it ough and tenacious. As this bird often builds against perpendicular wall, without any projecting ledge nderneath, it requires its utmost efforts to get the first undation firmly fixed, so that it may safely carry the perstructure. On this occasion, the bird not only lings with its claws, but partly supports itself by rongly inclining its tail against the wall, making that fulcrum, and, thus steadied, it works and plasters the aterials into the face of the brick or stone. But then, at this work may not, while it is soft and green, pull self down by its own weight, the provident architect as prudence and forbearance enough not to advance er work too fast; but by building only in the morning, nd by dedicating the rest of the day to food and amuseent, gives it sufficient time to dry and harden. About alf an inch seems a sufficient layer for a day. Thus areful workmen, when they build mud walls (informed first perhaps by these little birds), raise but a oderate layer at a time, and then desist, lest the work

should become top-heavy, and ruined by its own weight. By this method, in about ten or twelve days is formed an hemispheric nest, with a small aperture towards the top, strong, compact, and warm, and perfectly fitted for all the purposes for which it was intended."

Some birds work in wood, and may be termed carpenters. The nuthatch, before mentioned, on account of his qualifications as a mason, is believed to enlarge the hole in the tree when that is necessary. Both the tomtit and the woodpecker, with their sharp beaks, excavate altogether a hole in a tree, and, moreover, they carefully carry away the chips, so as not to give any unnecessary indication of their whereabout. Wilson relates of an American woodpecker, that the excavation it makes in a tree is sometimes five feet in depth, and that it is winding, so as to keep out the rain and wind.

Ill calculated as the structure of the bird seems to be for either mining or working in wood, it seems still less so for sewing. There are nevertheless some birds—none, however, inhabiting this country—who are led by their instincts to construct their nests in this last-mentioned manner. The orchard starling is an example of this. It usually suspends its nest from the twigs of an apple tree, and uses for its material a tough species of grass, *pieces of which* are sewed through and through. Wilson *detatched* one of the stalks of this, and found it thirteen

inches long, and that it went in and out like a thread thirty-four times. The tailor bird of the East Indies, is a still more remarkable instance of this instinctive sewing: Forbes watched it constructing its nest, and he observed it to select a plant with large leaves, next gather cotton, spin the cotton into a thread by means of its bill and feet, and then sew the leaves together, using its beak as a needle, or rather, awl.

Other birds construct their nests in a manner analogous to weaving; others are led by their instincts to cover their nests with a dome, and still farther peculiarities might be cited. Passing over these, however, we may notice some strange instincts which lead particular species of birds to dispense with building a nest altogether, and to use one built by another bird or mammal. Most of the hawks and owls take possession of the nests of crows, ravens, squirrels, &c. Sparrows, too, are very apt to take by force the nests of swallows and other birds; but this does not seem to be the result of instinct, but to be an acquired habit, a piece of roguery, the result of reasoning, for the sparrow can make upon occasion a very good nest for itself. But the most remarkable bird in this respect is the cuckoo. This never constructs a nest of its own, but lays its egg in that of another bird, where it is hatched. The instinct of the parent *cuckoo always* leads it to select the nest of an

insect-feeding bird, and it also prefers a small nest. it neglected the former, its young when hatched wou starve, as the cuckoo lives on animal food; and the la ter is one of the best indications of an instinct that c be found. The young cuckoo, as soon as it is hatche is taught by its instinct to pitch out its foster brothe and sisters, in order that it may get all the meat to itse To effect this, it creeps under the other little fledglin clambers backwards, and ejects it from the nest by jerk; and the pertinacity with which it repeats this pr cess until it effects its object is very great. But if were in a large nest it could not succeed in its purpo whereas in a small one it can hoist it over the side. is quite incredible that the mother cuckoo can fores this at all; and her selecting the nest of a little hed sparrow, or even of a still less wren, in which to depo her egg, must be altogether instinctive. Another ve curious fact with regards to the young cuckoo is, th while newly hatched birds have in general their bac convex, that of the young cuckoo has a depression the middle, which forms a lodgement for the other you birds. If the cuckoo is hatched before the other eg are, it takes these eggs and throws them over.

Owing to the activity of flight and the shy nature most birds, we know little of the instinctive actions th *serve a common* purpose of those that live together

societies. And indeed it has been affirmed, that when birds do live together, no instinctive actions are performed for a common end or a common safety. But some such unquestionably are, and probably a great many more than we have ever observed exist. The crane and the wild-goose would seem to elect a leader, and almost all gregarious birds appoint sentinels. Every body must have seen the sentinels of crows, and noticed their extreme watchfulness. So also do sparrows, and sparrow sentinels keep a very strict watch, especially for cats, and on the approach of one of their feline enemies at once give the alarm. Sparrows, too, frequently hold assemblies, or sparrow-courts as they are called, and appear in them to be scolding and perhaps beating one of their number; and it has been conjectured that they are punishing a delinquent sentry. So, also, there are crow-courts held, and probably for a similar purpose. The internal economy of a colony of rooks is certainly subject to a regular police. "I have often," wrote Goldsmith, "amused myself with observing their plan of policy, from my window in the temple, that looks upon a grove where they have made a colony in the midst of the city. At the commencement of spring, the rookery, which, during the continuance of winter, seems to have been deserted, or only guarded by about five or six, like old soldiers in a garrison, now begin

to be once more frequented, and in a short time all the hurry and bustle of business is fairly commenced. Where these numbers resided during the winter it is not easy to say, perhaps in the trees of hedge-rows, to be nearer their food. In spring, however, they cultivate their native trees; and in the place where they were themselves hatched, they prepare to raise a future progeny. They keep together in pairs, and prepare for making their nests and laying. The old inhabitants of the place are all already provided, the nest which served them for years before will, with a little trimming and dressing, serve them very well again. The difficulty of nesting lies upon the young ones who have no nest, and who, therefore, must get up one as well as they can. But not only are the materials wanting, but also the place in which to fix it. Every part of a tree will not do for the purpose, as some branches may not be sufficiently forked, others may not be sufficiently strong, and still others may be too much exposed to the rocking of the wind. The male and female, upon this occasion, are for some days seen examining all the trees of a grove very attentively; and when they have fixed upon a branch that seems fit for their purpose, they continue to sit upon it, and observe it very sedulously for two or three days longer. The place being then determined upon, they *begin to g*ather the materials for their nest, such as

sticks and fibrous roots, which they regularly dispose in the most substantial manner. But here a new and unexpected obstacle arises. It often happens that the young couple have made choice of a place too near the mansion of an older pair, who do not choose to be incommoded by such troublesome neighbours; a quarrel, therefore, instantly ensues, in which the old ones are always victorious. The young couple, thus expelled, are obliged again to go through their fatigues—deliberating, examining, and choosing; and, having taken care to keep their due distance, the nest begins again, and their industry deserves commendations. But their activity is often too great in the beginning; they soon grow weary of bringing the materials of their nests from distant places, and they very early perceive that sticks may be provided nearer home, with less honesty indeed, but some degree of address. Away they go, therefore, to pilfer as fast as they can, and, whenever they see a nest unguarded, they take care to rob it of the very choicest sticks of which it is composed. But these thefts never go unpunished, and probably, upon complaint being made, there is a general punishment inflicted. I have seen eight or ten rooks come upon such occasions, and, setting upon the new nest of the young couple, all at once tear it to pieces in a moment.

At length, however, the young pair find the necessity

of going more regularly to work. While one flies to fetch the materials, the other sits upon the tree to guard it; and thus in the space of three or four days, with a skirmish now and then between, the pair have filled up a commodious nest, composed of sticks without, and of fibrous roots and long grass within. From the instant the female begins to lay, all hostilities are at an end; not one of the whole grove, that a little before treated her so rudely, will now venture to molest her, so that she brings forth her brood with perfect tranquillity. Such is the severity with which even native rooks are treated by each other; but if a foreign rook should attempt to make himself a denizen of their society, he would meet with no favour, the whole grove would at once be up in arms against him, and expel him without mercy."

CHAPTER VI.

THE INSTINCTS OF MAMMALS.

'E may commence the account of the indications of nct that occur in mammals, and which are much less ırkable than those which may be witnessed in the r animals, by some notice of the habits of one of the st of them, and one that manifests little or no signs telligence. This is the common mole of our fields; nimal that leads a subterranean life, and scarcely ɜsses the faculty of vision; indeed, it is probable its very minute specks of eyes only suffice to inform at it has come into contact with the light of the and is therefore in the midst of danger from which nnot defend itself.

ıis insignificant animal, "the little gentleman in black ɜt" of the Jacobites, is led by its instinct to construct ʏ elaborate underground dwelling. Underneath a ɜk, in some secure place, it makes its headquarters rtress. This is roofed by a compact cement, which nimal has beaten and spread as plaster. Two gal- ı are formed in it, one at the bottom, and one higher hich communicate together by means of five tunnels ssages. From this fortress, which is used as a dor- ʏ, a number of excavations proceed, each somewhat

larger than is necessary to allow a mole to proceed, but not of such extent as to permit two to pass. These roads constitute the animal's hunting-grounds, in which he seeks for worms; and he is continually extending them, the indefatigable miner throwing to the surface the earth that he displaces, and thus forming molehills. In making all these tunnels the mole is led by its instincts to select a depth which varies according to the nature of the soil and the surface. Sometimes they are not more than four inches down from the surface; but if a road or a stream have to be undermined, they sometimes extend to the depth of nearly two feet. It has also been noticed that, when food is scarce, a number of branch tunnels are made, and that the depth of these is regulated by the consistency of the soil, being deepest in heavy and humid ones, where the worms burrow low; indeed, in very light gravely soils, it comes almost to the surface, and the tunnel becomes nearly a trench.

The mole is a thirsty creature, and accordingly it is led by its instincts to invariably provide for a due supply of fluid. Generally it contrives to be near a stream; but if, probably when it is driven from such convenient localities by a stronger mole (for moles are very pugnacious animals, and do not endure rivals,) it is compelled to erect its fortress in a dry place unprovided with a stream, it sinks deep wells. These are perpendicular

shafts, and may be often observed quite full of the water that has gathered in them.

Le Court, to whom we are indebted for most of our knowledge of the habits of the moles, made an experiment which demonstrated the very considerable rapidity with which the mole progresses in its tunnels. He took one day advantage of a mole being out hunting at the extremity of its domain, and he placed along the course of the high-road or main tunnel that led from where the animal was engaged towards the fortress, several little flags of coloured paper, the staffs of which were single straws which he stuck upright through the centre of the tunnel. Near the end of the road he inserted a horn, having its mouthpiece projecting out of the earth. When his arrangements were all completed he blew a blast upon his horn, upon hearing which the terrified mole was immediately impelled by its instinct to make for its fortress; and of the rapidity with which this was done, some idea could be formed by observing how fast in succession the flags fell, from the animal in its flight displacing the straws. The observers thought that it ran about as fast as a horse can trot.

There is the *Mus messorius*, or small mouse, the least of all British quadrupeds (White found that two of them weighed only as much as a copper halfpenny,) which shows curious indications of building instincts. Its nest

for its young is suspended on a corn-plant, a thistle, or some other small vegetable. One of these nests was found by Gilbert White. "One of these nests," he wrote, "I procured this autumn, most artificially platted, and composed of blades of wheat perfectly round, and about the size of a cricket-ball, with the aperture so ingeniously closed that there was no discovering to what part it belonged. It was so compact and well filled that it would roll across the table without being discomposed, though it contained eight little mice that were naked and blind. As the nest was perfectly full, how could the dam come at her litter respectively, so as to administer a teat to each? Perhaps she opens different places for that purpose, adjusting them again when the business is over; but she could not possibly be contained herself in the ball with the young ones, which, moreover, would be daily increasing in size. This wonderful procreant cradle, an elegant instance of the efforts of instinct, was found in a wheat-field, suspended on the head of a thistle."

This little mouse, too, in winter, if not carried by the harvesters into a stack, makes burrows in the ground, which it lines comfortably with grass, and in which it keeps itself warm during the cold weather.

A much larger animal belonging to the mouse family, the hamster, is common in the north of Europe, where *it commits* great ravages upon the farmer. It is im-

elled by its instinct to construct both subterranean wellings and subterranean barns. It first burrows own obliquely to form an entrance; at the end of this he male constructs one perpendicular shaft, and the male several. At the terminations of these latter, everal vaults are excavated, which serve for their own wellings, for the reception of their young, and for store-ooms; and it is stated that for every different kind of orn a different vault is constructed. In a complete tablishment the vaults will sometimes go down to a epth of between four and five feet, and the whole col-ctively will have a diameter of eight or ten feet. The partments intended for residence are well lined with ass. When the hamster is out foraging, after having tisfied his appetite, he fills his cheek-pouches with corn ntil they become enormously distended. In this state repairs to his granaries, and, after having carefully parated the chaff, hoards it up. As the winter's cold creases, he stops up the entrance to his premises, and epares for hybernation, during the intervals of which subsists upon the food that he has instinctively laid . The peasants hunt out these burrows of the ham-ers, out of which they commonly obtain about two shels of corn.

As is well known, rats, in like manner, store up food ainst a time of scarcity. Squirrels, too, afford us ex-

amples of instinctive storing of food and constructing residences. Our common European squirrel constructs its abode of moss and dried leaves, which it packs between the fork of two branches of a tree, and in a hole near it stores up nuts for its winter use. An American ground squirrel makes a burrow in the ground, at the root of a tree, where it lays up a great quantity of winter food; and when the cold becomes severe it ensconces itself in it, having previously taken the precaution of making more than one outlet. The common hedgehog of this country also constructs a house for its winter residence; but this animal is not known to store up food.

Another mammal that constructs a habitation is the badger. It excavates a subterranean house, which enters by a passage, that soon divides into several chambers, but that eventually terminates in an apartment, well lined with hay. The beaver, also, affords very striking indications of instinct in his building arrangements; but these have been noticed in the *Natural History of Creation.* But it must be admitted that almost all the instinctive movements of mammals are far less extraordinary than those of beings lower in the scale; and also that, in investigating them, it is much less easy to decide how much is purely instinctive, how much decidedly intellectual, and how much the result of original instincts, added to and improved by acts of reasoning upon experience.

CHAPTER VII.

THE REASONING POWERS OF THE HIGHER ANIMALS.

No one who has watched the decidedly instinctive ctions of the higher animals, can have failed to have oticed with how slight a degree of intensity they are anifested when compared with those of animals lower n the scale. There is the bee, for example, an insigni- icant insect that is led by its instinct to store up a upply of food; and we have seen with what an ardour nd determination it persists in obeying that instinct. Nothing save death can arrest it in laboriously hoarding p honey every summer day. Then there is the hamster, n animal much higher in the scale, which also uniformly nd persistently puts by food for future use. The dog, very high animal, has likewise this propensity to ga- her food and store it for an after day's consumpt; nd his instinct teaches him to bury bones and meat in he ground. But he only occasionally obeys that in- *tinct, and the* slightest accident deters him from his

purpose. Nay, he may be made to understand that his master disapproves of the custom, in which case he will probably entirely discontinue the practice.

When, as in this last-mentioned case, the dog desists from concealing food in the ground because he finds his master dislikes the habit, he clearly does not act from an instinct, but from a process of reasoning that passes through his mind. An exceptional case from any thing that could occur to him in a state of nature happens, and he meditates upon it, and finally decides upon a line of conduct. It is not an irresistible impulse that he obeys, the result of which he knows not of, nor cares about; on the contrary, he restrains the strong desire that he has to conceal the superfluous meat, and he does so because he judges that if he hide it he may be punished, if he do not that he may be caressed or praised, and that a due supply of food will always be given to him. Accordingly, in all the higher animals, indications of reasoning upon facts that have been experienced, and decisions evidently adopted for particular cases, and often modified in each individual case, are to be plentifully witnessed.

These begin to manifest themselves pretty low down in the scale, although at first it is not easy to draw the line of demarcation very exactly as to where the purely instinctive movements become mixed up with actions *performed* under the guidance of reason. None of the

atter probably exist in any beings lower than insects; nd, even among insects, only two or three such have een observed, and even these comparatively simple and asignificant ones. One of the most remarkable of them as observed by Colonel Sykes, in the case of some lack ants in India. This gentleman's dessert, which onsisted of fruit, cake, and preserves, was always alowed to remain in a verandah that opened off his dinng-room. The ants found this out, and attacked the essert. In order to keep them off, the legs of the table ere immersed in pails of water. At first this proved ffectual; but the dessert was so tempting, that the ants t length braved the water, and plunging in, managed o scramble to one of the legs and ascend the table. very morning the dessert table was found covered by undreds of them. The legs of the table were then ainted just above the water, with a circle of turpentine, hich for some days appeared to completely defend the essert from the attacks of the ants. However, in a little hey were again found in the mornings as thick as ever, nd plundering at the sweets; and it was at last disovered that the ants had hit upon the plan of creeping up he wall, proceeding to the ceiling over the table, and then etting go their hold they tumbled among the viands that hey were so hungry to eat. This last expedient must ertainly have been the result of a reasoning process.

The drones of the wasp, too (wasp drones, as before mentioned, are the scavengers of a wasp nest,) assist one another in removing any dead wasps from the nest; and, if the corpse is too heavy for them, they have often been noticed to sever it in two, and remove each part separately. Something analagous to this has been observed with regard to ants. Lyon experimented upon these insects in Barbadoes, and thus reports:—"We sometimes kill a cockroach and throw him on the ground, and mark what they (the ants) will do with him; his body is bigger than a hundred of them can carry, and yet they will find the means to take hold of him and lift him up, and, heaving him above ground, away they carry him, and some go bye as ready assistants if any be weary, and some are the officers that lead and show the way to the hole into which he must pass; and if the van carriers perceive that the body of the cockroach lies across, and will not pass through the hole or arch through which they mean to carry him, order is given, and the body turned endwise; and this is done a foot before they come to the hole, and that without any stop or stay; and this is observable, that they never pull contrariwise."

It is, however, in the highest animals, as elephants, horses, and dogs, that we can behold pretty complex *actions* which are clearly the result of reasoning, and *performed* altogether in subjection to the animal's will.

Perhaps the property of the higher animals being able to understand to a certain extent the spoken language of man, and also of communicating to one another ideas, or at any rate facts, and acting in consequence of that communication, not as the ants do, in one unvaried instinctive fashion, but according to the peculiarities of the case, afford us many conclusive proofs of the reasoning powers of the higher animals. Part of the former of these are undoubtedly owing to the animal coming to understand the expression of his master's face; but it is certain that some of the higher animals absolutely have acquired a certain understanding of language. Thus, if we speak French to a dog, he can come after a time to tell our meaning, and to obey us. If we then begin speaking English to him, he can understand nothing for a while, and requires to be educated over again until he has acquired his new language.

This power of the higher animals to understand by means of experience and reasoning, is certainly very remarkable. The tame elephant at the Jardin du Roi, immediately on hearing the words, *en avance*, without the slightest elevation of voice or gesture, made the desired movement. The manner in which our horses comprehend and are obedient to what is said to them, is matter of notoriety. Perhaps the best instance of this may be noticed among Scottish farm-horses. It is the custom

in Scotland to plough, &c., with a pair of horses, which are yoked together, and which are directed in their proceedings (which are a great deal more complicated than the uninitiated would suppose) almost entirely by the spoken orders of the man who holds the stilts of the plough, no boy leading them, as is the case in England. Not only do they perfectly understand the order to stop, to move slower or faster; but when the man cries *hi*, they turn round to the right side, and when *hup*, to the left. In fact, so well do the horses understand farming, and so willing are they to do what is right, that a distinguished agricultural writer* has declared his belief, that in the rare case when the horses and the man quarrel in the field, the horses will be found to be right, and the man wrong.

It would seem, too,† that the domesticated animals have an artificial language, acquired by experience, and used in accordance to reason. The wolf, or the fox, or the wild-dog, if caught in a trap, or even if put to a painful and violent end, never cry out. Will Crane, the huntsman to one of the Lords Fitzwilliam, during the whole course of his great fox-hunting experience, never heard but one fox cry out when being worried by the

* Mr. Stephens.

† *As mentioned* in the *Natural History of Creation*, even the highest *animals only* possess this power to a small degree.

unds. This strongly contrasts with the cry of a mesticated dog, for example, even when slightly struck. it the higher animals possess several sounds which ey appear to be able to interpret accurately enough. iese have been particularly attended to by M. de la alle, who acquired such a perfection in the language the higher animals, that he often succeeded in de- iving them. Indeed he did sometimes to his own st; for seeing his own dog, who was much attached to n, approaching, he uttered the cry of defiance, upon iich the animal flew upon him and bit him in the leg. ie dog immediately discovered his mistake, and threw nself howling upon the ground, beseechingly looking pardon. At other times he was not so accurate in imitations, and the animals were not deceived. Upon ese occasions, their looks sometimes expressed their ntempt at his failure, but at others they received it th a grave expression of irony, as if they understood d appreciated the joke.

This same gentleman was acquainted with the Count Fontenay, who, in concert with the Marquis des Feu- rets, was engaged in some experiments relative to the eeding of Merino sheep. The count had a particularly telligent pointer. One day he was anxious to send a tter to Feugerets, but he had no messenger at hand. It *curred to him* that perhaps his dog might do, and

accordingly he tied the letter to the collar of the pointe and said, "Carry that to Feugerets." The dog did s he was desired, and, when he arrived at his destinatio would permit no one to touch the letter except the ma quis. Subsequently he was often employed in th manner. "I have seen this dog," says La Malle, "f four or five years acting as messenger between the tw chateaux with remarkable quickness and fidelity. Wh the dog delivers the letter he goes to the kitchen to fed; as soon as he has had his meat, he sits down befo the Marquis de Feugerets' study window, and barks intervals, to shew that he is ready to take back t answer. On the letter being attached to the collar, sets off and then brings it to the count."

Indeed, we have instances of dogs understanding a obeying spoken language—in sheep dogs and in sporti dogs—which are too familiar to require mentioning, a which indicate a certain amount of reasoning. M. E wards knew a dog that was in the habit of seeking a bringing back gloves; and if by accident the word *ga* was mentioned in his hearing in the course of convers tion, he would immediately set out in search of som Another French dog was very fond of gingerbread, an whenever the name of that substance was spoken, wou get up in an excited state and run to the cupboard whe his favourite dainty was kept.

Not only do the higher animals understand, to a certain extent, what is going on, but they dwell upon them, so as to have their characters and dispositions changed or modified. "The dog which becomes so dainty when brought up in a lady's chamber, is ferocious with the butcher, submissive in the poor man's cabin, or thieving and cringing with the beggar. When standing at the nobleman's lodge, he even adopts the tone and manner of the great man's porter. M. Edwards tells us that he has often seen dogs, educated by weak females, excessively timid, and that this timidity was transferred to their offspring. A terrier born in the house of M. De la Malle, and treated like a spoiled child by a kind-hearted woman who amused herself with speaking to it all day, had its sensibility brought at six months' old to such a state, that when its mistress caressed her cat, or pretended to scold the little animal, its large eyes would fill with tears, and it would end by crying like an infant."

Although wandering from the subject before us, we may state that the converse is the case, and that uncivilized and ill-educated men really have their characters somewhat modified by the animals among whom they dwell. Dr. Virey, perhaps, has pushed this farther than any body. "Behold," he says, "those men who pass their lives among animals, as cowherds, shepherds, swineherds, grooms, and poachers, they always acquire

the nature of the brutes with which they are brought in contact, and they contract analogous manners, morals, and even odours. It is thus that man becomes heavy and rude with the ox, filthy and a glutton with the pig, simple with the sheep, courageous, and an adept hunter with the dog. In like manner, the Arab is sober with his camel, the Tartar rough and blunt as his horses, the Laplander timid as his reindeer, the mountaineer active as the goat, the African impudent as his ape, the Indian sombre as his elephant, because it is man's fate to take the nature of his animals when he cannot form their nature to his."

One animal sometimes acquires the habits of one of another species, and this implies observation, and that trains of thought regarding the things observed, have passed through its mind. One of the most remarkable instances of this was observed by La Malle. This gentleman had a kitten which had attained the age of six months, when his live stock was increased by the presence of a terrier pup, Fox, that was only two months old. The dog and the cat were brought up together, and Fox for two years had no association with other dogs, but received all his education from the three daughters of the porter, and from the cat. The two animals were continually together, and acquired a great affection for one another; the cat however, as the senior, taking the

ad. Soon Fox began to bound like a cat, and to roll mouse or a ball with his fore-paws after the feline shion. He also licked his paw and rubbed it over his r as he saw the cat do; nevertheless, owing to his tive instinct, if a strange cat came into the garden e chased it away. M. de la Malle brought a strange og into the house, who manifested the utmost contempt d indignation for all Fox's habits. M. Andouin, too, d a dog which acquired all the habits of a cat.

Both dogs and cats have often been known to have erceived the result of ringing bells, and knocking door-nockers, and to have done such for similar purposes. I. de la Malle had a dog which he brought from his ountry house (where he had no knockers on his doors) Paris. On the day of his arrival this animal went t of the house, but, feeling apparently fatigued, had e desire to return. It happened, however, that the oor was shut, and it endeavoured, but in vain, to tract attention within by barking. At length a anger calling, raised the knocker and gained admit-nce. The dog noticed what had been done, and came along with him. That same afternoon he went in and t half a dozen of times, gaining ingress upon each casion, by using the knocker of the door.

Two very good examples of this kind on the part of ts are recorded. One occurred under the personal

knowledge of Archbishop Whately. "This cat," h says, "lived many years in my mother's family, and it feats of sagacity were witnessed by her, my sisters, an myself. It was known, not merely once or twice, bu habitually, to ring the parlour-bell whenever it wishe the door to be opened. Some alarm was excited on th first occasion that it turned bell-ringer. The family ha retired to rest, and in the middle of the night th parlour bell was rung violently; the sleepers wer startled from their repose, and proceeded down-stair with poker and tongs, to intercept, as they thought, th predatory movements of some burglar; but they wer equally surprised to find that the bell had been rung b pussy, who frequently repeated the act whenever sh wished to get out of the parlour.". Mr. Crouch wa acquainted with a cat that could open a lock. "There was," writes that gentleman, "within my knowledge, i the house of my parentage, a small cupboard in which were kept milk, butter, and other requisites for the tea table, and the door was confined with a lock, which from age and frequent use could easily be made to open. To save trouble, the key was always kept in the lock, in which it revolved on a very slight impulse. It was often a subject of remark, that the door of this cupboard was found wide open, and the milk or butter greatly diminished without any imaginable reason, and notwith-

standing the persuasion that the door had certainly been regularly locked; but it was accident that led to the detection of the offender. On watching carefully, the cat was seen to seat herself on the table, and by repeated pulling on the side of the bow of the key, it was at last made to turn, when a slight pull of the door caused it to move on its hinges. It had proved a fortunate discovery for puss for a long time before she was taken in the fact."

Then the "learned" dogs, horses, and pigs, afford very convincing proofs that these animals are capable of a certain amount of reasoning. There is no great difficulty in teaching dogs to open and shut doors, ring bells, and the like, when ordered. They may also, by perseverance, be taught to do much more complex actions. Thus, a dog belonging to Mr. Wilkie, could, when commanded, feign very accurately all the agonies of death. He would, on such occasions, roll over on one side, stretch himself at length, move his hind-legs with a convulsive motion as if in extreme pain, and eventually fall on his back with his legs stretched out, and remain apparently a corpse, until his master permitted him to resuscitate. Every one has seen dogs, and even pigs, that can understand the meaning of some small signal from the showman, and pick up particular cards, letters, &c. The last-mentioned animal, the pig, is capable of a

considerable amount of reasoning. A pig has even been taught to point game. Pigs often become very clever in opening doors and gates; and of all the animals of the farm, the pig is the only one that is led by reasoning to hold a piece of solid food, as a turnip, fast with one foot, while it takes bites out of it with its mouth. A dog's holding a bone in like manner with its fore-feet, is not an instinctive habit, but one acquired by reasoning; and any one watching a young dog beginning to eat bones, will perceive that he is quite ignorant how to steady them.

Dogs of different kinds club or combine their talents for hunting, and proceed upon an arranged plan, which is unquestionably the result of observation and reason. "I had at one time," says M. de la Malle, "two sporting dogs, the one an excellent pointer with a very smooth skin, and of remarkable beauty and intelligence; the other was a spaniel with long and thick hair, but which had not been taught to point, but only coursed in the woods like a harrier. My chateau is situated on a level spot of ground, opposite to copse wood filled with hares and rabbits. When sitting at my window, I have observed these two dogs, which were at large in the yard, approach and make signs to each other, and first glancing at me, as if to see if I offered any obstacle to their wishes, step *away very gently*, then quicken their pace when they

were at a little distance from my sight, and finally dart off at full speed when they thought I could neither see them nor order them back. Surprised at this mysterious manœuvre, I followed them, and witnessed a singular sight. The pointer, who seemed to be the leader of the enterprise, had sent the spaniel out to beat the bushes, and give tongue at the opposite extremity of the bush-wood. As to himself, he made with slow steps the circuit of the wood by following it along the border, and I observed him stop before a passage much frequented by rabbits, and there point. I continued at a distance to observe how the intrigue was going to end. At length I heard the spaniel, which had started a hare, drive it with much tongue towards the place where its companion was lying in ambush, and the moment that the hare came out of the passage to gain the fields, the latter darted upon it and brought it to me with an air of triumph. I have seen these two dogs repeat this same manœuvre more than a hundred times; and this conformity has convinced me that it was not accidental, but the result of a concerted agreement and combined plan of operations concerted beforehand."

There was a dog that lived in a strict monastery where the monks dined alone, and who, instead of asking for their meals, obtained them by knocking at the buttery door, the cook answering by opening the door and push-

ing the allowance through. The dog observed this proceeding, and accordingly knocked at the door, and laid in wait until the meat was placed outside, and the door shut, when he ran off with it. This he repeated a number of times.

If we course a hare with an old greyhound and a young one, we have examples of both instinct and reason. The young one instinctively pursues his game, following every turn and winding, and the old one, under the influence of reasoning and experience, knows that the hare will double, and accordingly does not exactly follow her, but goes across.

It may be here observed, however, that any practice of an animal acquired by reasoning, is very easily put out and supplanted by an instinct. For instance, when two strange rams meet they instinctively fight. If, however, two are brought up together from being young, they seem to become convinced of the propriety of being on good terms, and live amicably enough. When, nevertheless, they are sheared, the difference of their appearance causes their instincts to come out in their primitive force, and they fight desperately, and sometimes until one is killed. We return, however, to the narration of some acts decidedly performed under the influence of reason.

It has been noticed in South America, that when

unting the deer there with newly imported dogs, the dog, vhen he approaches his game, flies at it in front, and very ften gets his neck broken by the violence of the shock. But the native dogs carefully avoid this instinctive im- ulse, and have learned the danger of it, and they nvariably remove to one side and attack the stag in lank.

Something similar has been noticed with elephants. Thus it is recorded on good authority, that in Cochin China a party of seventy elephants, mounted by their guides, were set off to hunt tigers. A tiger being found, one of the more advanced elephants was driven to attack it. The wild beast remained crouched until the elephant was going to strike it with his tusks, when it gave a sudden spring, alighted upon the elephant's neck, and severely wounded him. All the other elephants immediately so arranged their trunks, that if the tiger attempted to repeat his plan of operations upon them they could foil him.

Lord Brougham's translation of an old Spanish account of the beggar's dog, is pleasing in itself, and curious as a very happy imitation of old English. "The blind man's dog," he translates, "will take him to the place where he may but hope to get his alms, and bring him thither through the crowd by the shortest and the safest way; he will take him out of the city some miles to the great church

of St. Paul's, as you go to Ostia.* When in the street he cometh to a place where several ways meet, and with the sharpness of ear that the blind have, guided by some sound of a fountain, he gives the string a jerk by either hand, straightway will the poor dog turn and guide him to the very church where he knows his master would beg. In the street, too, knoweth he the charitably disposed houses that be therein, and will lead thither the beggar man, who stopping at one, saith his paternoster, then down lieth the dog till he hear the last word of the beadsman, when straight he riseth and away to another house. I have seen myself, to my great joy mingled with admiration, when a piece of money was thrown down from some window, the dog would run and pick it up, and fetch it to the master's hat; nor when bread is flung down will he touch it, be he ever so hungry, but bring it to his master, and wait till he may have his share given him. A friend of mine was wont to come to my dwelling with a great mastiff, which he left by the door on entering; but he, seeing that his master had entered after drawing the string of the bell, would need do likewise, and so made those within open the door, as though some one should have rung thereat."

The manner in which tame elephants assist in cap-

* *The Spaniard* is describing the blind beggars' dogs at Rome.

turing wild ones, affords us an instance of reasoning in an animal. The elephant-hunters, attended by two or sometimes four domesticated elephants, pursue their intended victim cautiously. The tame ones affect to be grazing, and as if, like him, they were in a state of nature; while the hunters, well provided with strong ropes, conceal themselves close by. The elephants gradually approach the wild one, and endeavour to establish an intimacy. If they succeed in attracting his attention, the hunters contrive to tie strong ropes to his legs, and, if practicable, it is said that the decoy elephants actually lend a hand, or rather a trunk, in this operation. If a large tree be near, the other end of the ropes are at once bound to it, and the decoys leave; and if no tree be near he is allowed to walk away, trailing the cables after him, until he approach one, to which he is fastened. When he discovers that he is secured he is most furious, but he is allowed to remain without food until sufficiently tamed, when he is taken to the station of the hunters, under the guard of his treacherous friends.

The following very curious anecdote relative to two elephants, exhibits perhaps the most remarkable reasoning powers ever observed in animals. It is related by Griffiths, "At the siege," writes that gentleman, "of Bhurtpore, in the year 1805, an affair occurred between

two elephants, which displays at once the character and mental capability, the passions, cunning, and resources, of these curious animals. The British army, with its countless host of followers and attendants, and thousands of cattle, had been for a long time before the city, when, on the approach of the hot season and of the hot dry winds, the supply of water in the neighbourhood of the camps necessary for the supply of so many beings began to fail, the ponds or tanks had dried up, and no more water was left than the immense wells of the country could furnish. The multitude of men and cattle that were unceasingly at the wells, particularly the largest, occasioned no little struggle for the priority in procuring the supply for which each were there to seek, and the consequent confusion on the spot was frequently very considerable. On one occasion two elephant-drivers, each with his elephant, the one remarkably large and strong, and the other comparatively small and weak, were at the well together; the small elephant had been provided by his master with a bucket for the occasion, which he carried on the end of his proboscis, but the larger animal, being destitute of this necessary vessel, either spontaneously, or by the desire of his keeper, seized the bucket, and easily arrested it from his less powerful fellow-servant; the latter was too sensible of *his inferiority* openly to resent the insult, though it is

bvious that he felt it; but great squabbling and abuse nsued between the keepers. At length the weaker nimal, watching the opportunity when the other was tanding with his side to the well, retired backwards a ew paces in a very quiet and unsuspicious manner, and hen, rushing forward with all his might, drove his head gainst the side of the other, and fairly pushed him into he well.

"It may easily be imagined that great inconvenience vas immediately experienced, and serious apprehensions uickly followed that the water in the well, on which he existence of so many seemed to depend, might be poiled, or at least injured, by the unwieldy brute that vas precipitated into it; and as the surface of the water vas nearly twenty feet below the common level, there lid not appear to be any means that could be adopted o get the animal out by main force, at least without njuring him; there were many feet of water below the lephant, who floated with ease on the surface, and, xperiencing considerable pleasure from his cool retreat, vinced but little inclination even to exert what means e might possess in himself of escape.

"A vast number of fascines had been employed by he army in conducting the siege, and at length it ccurred to the elephant-keeper that a sufficient number f these (which may be compared to bundles of wood)

might be lowered into the well to make a pile, if the animal could be instructed as to the necessary means of laying them in regular succession under his feet. Permission having been obtained from the engineer officers to use the fascines, which were at the time put away in several piles of very considerable height, the keeper had to teach the elephant the lesson, which, by means of that extraordinary ascendancy these men attain over the elephants, joined with the intellectual resources of the animal itself, he was soon enabled to do, and the elephant began quickly to place each fascine as it was lowered to him successively under him, until in a little time he was enabled to stand upon them; by this time, however, the cunning brute, enjoying the pleasure of his situation after the heat and partial privation of water to which he had been lately exposed (they are observed in their natural state to frequent rivers and to swim very often,) was unwilling to work any longer, and all the threats of his keeper could not induce him to place another fascine. The man then opposed cunning to cunning, and began to caress and praise the elephant; and what he could not effect by threats he was enabled to do by the repeated promise of plenty of rack.* Incited by

* It is common to prevail upon elephants to execute a hard piece of work by the promise of arrack, cake, &c., and the animals appear to *understand the* promise perfectly.

this the animal again went to work, raised himself considerably higher, until, by a partial removal of the masonry round the top of the well, he was enabled to step out; the whole affair occupied about fourteen hours."

Tales, almost equally wonderful, are told of the sagacity of dogs. For instance, before smoke and spring-jacks became common, it was the custom to turn the spit by means of a large hollow wheel in which a dog was placed, and which, by constantly trying to advance, it turned. Arago, the lamented astronomer, was detained by a storm at a country inn, and ordered a chicken for his dinner. Arago was warming himself by the kitchen fire, and saw the innkeeper put the fowl on the spit and attempt to seize a turnspit dog lying in the kitchen. The brute, however, refused to enter the wheel, got under a table, and shewed fight. On Arago asking what could be the meaning of such conduct, the host replied that the dog had some excuse, that it was not his turn but his comrade's, who did not happen to be in the kitchen. Accordingly, the other turnspit was sent for, and he entered the spit very willingly, and turned away. When the fowl was half roasted Arago took him out, and the other dog, no longer smarting under the sense of injustice, now took his turn without any opposition, and completed the roasting of the fowl.

In like manner dogs may be taught to steal. During the last century sheep-stealing was a very common crime in the south of Scotland, the thieves being always very much assisted by their dogs, which were educated for the purpose. Towards the close of it there was one man who went about, accompanied by his dog, pretending to buy sheep, and, while handling them, pointed out to the animal which he desired to be stolen. At night the dog went to the flock, singled out the particular sheep, and conducted them to its master by bypaths and unfrequented routes. Eventually these were discovered, and both were hanged. Sometimes dogs steal sheep on their own account; and Sir Thomas Wild knew of one that had the cunning to slip its collar at night when he wished to depart, and to slip it back on his return. Lastly, but the other day, the papers contained an account of a novel mode of robbery, in which a dog ran about frightening the people of the house, while its human confederates robbed it.

This is not the place to enter into the consideration of the nature of these mental acts of animals, or to draw any influence from them. We may be content with remarking that the result of those reasoning powers of the higher brutes is, after all, only physical movement.

CHAPTER VIII.

THE INSTINCTIVE BELIEFS OF MAN.

"THE man who meditates," says Rousseau, "is a depraved animal." And if we regard man as an animal, the saying is unquestionably true; for with meditation and its result—civilization, come disease and debility, and often premature death: in fact, a diminution of animal activity and perfection. But the man who does not meditate is a depraved spirit; for the truth is, that man is not an animal. The sagacious elephant and the meanest moss have a common connection with matter, and a common vitality, and so, also, have the elephant and man a mutual life; but the difference that exists between the two last, is far greater than between the intelligent animal and the weed. Man comes into this world naked, and he clothes himself; without an instrument of offence or defence, and he constructs weapons, by means of which he can subdue the wildest, the strongest, and the most furious of brutes; ignorant, and he discovers the secrets of the heavens, and reveals antiquity. But,

perhaps the most striking distinction of all is, that man is not under the control of instinct. With the exception of what are, perhaps, acquired habits of throwing the hands forward when falling, or winking the eye when a substance approaches that organ, the adult man has not a single instinct.

We have seen that mental acts take place in the higher animals, and that the actions of many of them are, to a considerable extent, guided by reason. When we come to man, we find *all* his actions placed under the control of reason. Man, it is true, has corporeal relations: the matter that forms his structure is the same as that which forms the rock on which he treads, and is, indeed, derived from it; and like it too, when brought under the influence of gravitation, it obeys the attractions of that power. It has not, however, been immediately derived from the soil, but its substance has previously been passed through vegetables, which have prepared and introduced this matter, as it were, into his frame, and, in common with these vegetables, man enjoys or he suffers, as the case may be, the endowments of vitality. Like the plants, he springs into being, acquires matter from without, exhibits certain functions, and performs certain motions; and at last dies, and his identity as a physical structure, like the identity of a *dandelion* or a groundsel, is lost. He is surrounded

by still higher vitalized beings than even exogenous plants, many of whom he compels into his service. Of these animals, some only differ from plants, in that their motions are performed under the influence of an instinct that seems to be attended with a vague consciousness of external impressions; but the higher of them perform definite actions clearly under the direction of a sentient principle that has observed what was passing around, and owing to meditation upon such inferred deductions. We have also seen that there was a time when matter was under the influence of the laws of gravitation only, but that even then there were different modifications of it, and that the globule of platinum tended more rapidly to the common centre than its bulk of hydrogen; that then came the rule of chemistry; but that, under its sovereignty also, various elements had very varying attractions for one another, and that next vitality came on the scene; and we do not wonder to find in its progeny very varying powers, from those of the instinctive mushroom or coral, to those of the still instinctive, but also reasoning dog, or elephant. When we come to man, we find something more than the corporeal structure, the instinctive motion, and the reasoning that exists in mammals. We do not find pure reason that has, and can have, no doubt, or fear, or dread; but we find, and find distinctly, a new element—spirituality. Instinct,

says the apothegm, is ignorant that it knows, a reason knows that it is ignorant; but spirituality dc more—it hopes. Instinct acts by material impuls reason from material evidence; but spirituality proce upon the "faith, which is the evidence of things unse the substance of things hoped for."

Man is, indeed, devoid of instincts; and his reas if indeed it be of the same nature as that of the higl beasts, is as superior in its results as the instinct of the l is to the instinctive turning of the plant to light. I besides his corporeal connexion, and his exalted po of reasoning upon external objects, he has someth additional. When external objects are presented to senses, he does not instinctively act in some particu manner as the beasts do; but he observes, and refle and acts in accordance to the decision of his mind. I although his physical actions are under the contro his intellect, some of his mental operations are o nature analogous to the corporeal instincts of anim As when the first ray of light discloses to the yo water-bird or the young crocodile the water, each these makes for that element; so when certain prop tions—propositions, too, that have no connexion w matter—are made to man, his mind or his spiritual p at once believes them, and adopts them as part of *own being.*

There have been whole tribes, and there are at this ıoment in our country, many individuals who have ever been told that a great, a good, and a spiritual ɛing exists, who made this world, and who called man-ind into existence, and still watches and cares for his estiny. But whenever one has come from a distance) these first-mentioned savage tribes, and proclaimed that ıere was a superior Creator: that moment all who heard ıat saying believed it firmly and undoubtedly. In like ıanner, when one goes among our own poor, ignorant utcasts, and proclaims this, it is at once unhesitatingly ɛceived. Degraded as both are among the ranks of men, ill, unlike the brutes, they have no physical instincts, ut they possess, instead, this instinctive tendency to elieve in this great truth of the existence of a Deity henever it is proposed to them. And although, in high ates of civilisation, individuals may be found possess-ıg warped and inert spiritualities, (just as highly ampered hounds lose their instincts,) who profess to be ıperior to this spiritual law of their nature; yet even ith them, or with nearly all of them, when the hour of anger and strong dread of death come, nature reasserts er sway; and the mind, although the idea has been arefully banished for years, again instinctively believes, nd believes with rejoicing,—just as an animal exults in s material instincts—in an almighty and ruling Being,

To repeat this in other words: no animal either loves or fears, or at all believes in a power that is invisible to its senses; nor indeed does any operation pass through its mind that does not tend to some physical movement in that animal. Man has not only the power of forming, from his observations and reflections, abstract ideas that have no reference to physical movement; but he immediately and instinctively believes in the great abstract idea of the existence of a Deity whenever it is proposed to him; and after he has done so, let him endeavour to banish it from his mind as much as he will, yet if accidentally put into a state of nature, and removed from artificial trammels, he again falls back upon the old belief.

There is another, and perhaps still more remarkable property of the soul of man. No animal has any idea of futurity, not even of one to-morrow. Those that store up food for the winter, or even for another day, clearly do so under the influence of instinct, and not of reason; and even very few animals do thus instinctively act. The hunger, the thirst, or the enjoyment of the passing hour, are all that even the most intelligent of the animals care for; and to him the present is nearly all, the past little, and the future nothing. The want of fear that we sometimes admire in animals, is perhaps the *absence of* hope. Not so with man. With him me-

mories, however dear and beloved, actualities, however real and absorbing—all are as nothing as compared with his anticipations. Of all created beings connected with matter, at least of all of which we are cognizant, he alone spurns what has been, disregards what is, but toils and struggles for what is to be. He alone has the idea of another day, another week, another year. But this is not all.

There are nations or tribes, the members of which by their reason perceive that all created beings die: that the poppy, that so suddenly develops its gorgeous corolla, almost as suddenly returns to the soil from whence it so mysteriously sprang; that the dog that has so faithfully served them, soon becomes old, infirm, and at last perishes; and that those who live in the same huts as their members or associates, inevitably return to the dust. Such know, also, that the time will come when they too will have their last hunt, their last fight, their last look at the earth on which they tread, and the heavens under whose canopy they walk. Such may, and such do know no more than this. Nay, even in our own land, there are many, very many, who, although they excel the animals in this, that they can conceive the idea of to-morrow, and who know, although they banish the thought from their mind, that they must die, yet look upon death merely as an inevitable necessity, and whose notion of

futurity extends not beyond that last breath which will free them from a world of crime, and care, and sorrow.

But if to any of these tribes, or to these poor inhabitants of our country, any one declare, that there is an existence after this—a world of spiritual being after this world of mixture with matter, that moment it is instinctively or intuitively believed. There is no reasoning required, no proofs demanded, no inquiry made, no desire of explanation; the instant that the announcement reaches the mind, that same instant it is received. And although, in highly civilized states of society, individuals may be found who doubt it in their ordinary moments, yet even they, when they are softened by affliction, or the approach of death, return to their natural mental (not physical) instincts, and believe, even more firmly than they did before, that they will soon be in another state and being. True it is, that in matters of detail the prominent features of the future life vary in different states of civilisation and habit, just as the physical scenery of different countries varies. The futurity of the wild Indian is a vast hunting-ground, where he will be guided by the counsel of his ancestors; that of our own Scandinavian forefathers was a perpetual banquet; that of the oriental Musselman is scented with *odour, cooled* by flowing streams, and tended by beauty; *that of the* intellectual man is a higher sphere, where

loubts will be cleared up, and the actions of the mind
e unrestrained by the contact of matter; and that of
ivilized woman, a place where dear ties that have been
roken will be renewed, and where will flourish an ever-
asting rule of kindness, of mercy, and of love. But,
hatever be the station or position of the human mind,
he tidings of another world are never heard without
mmediate and instinctive belief; and when the idea has
nce possessed the mind, it is as fixed and permanent as
he industry of the bee, or the clinging to life of the wild
east.

This, then, is the argument. Ages ago it pleased an
ll-powerful Being to call into existence this matter that
s cognizable by our senses. What endowments he at
rst conferred upon it, it is impossible to discover; but
t one period he made it subject to the laws of gravitation,
o which laws a great portion of it is still liable. Sub-
equently, he bestowed upon the different elements of
t those extraordinary chemical affinities which, after a
tudy of nature for two thousand years, man is now be-
inning to discern, and which chemical affinities still
egulate the greater part of the unions that yet occur.
After this, it would seem to have been part of His will
o make various portions of matter unite so as to form
rganized beings, subject to the laws of vitality and

instinct. When we come to the higher of these we behold the operation of a new element—reason, which is supplementary to instinct in producing and causing motion. Then, leaving the animals, we come to a new being, man, connected in some mysterious manner with matter, but who is not under the control of instinct but of reason, and who produces, by means of that reason, not only physical movements, but mental abstractions; and who, moreover, instinctively believes, when told, in God and another state of being. And as we see in merely vitalized beings, that the instinctive desire to attain an end invariably concludes in that end being attained, so also, the instinctive beliefs of man will unquestionably be realised. That this will be so, may be learned from another and a higher source, but still it is the legitimate deduction from the study of that physical science which is so often thought to oppose revelation, and is from time to time set up to oppose it. And thus it is that from apparent darkness proceeds light, that faith springs out of doubt, and that, to use the words of the old Hebrew warrior, "out of the eater there came forth meat."

THE END.

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